REM IV

Remedial Planning Activities
at Selected Uncontrolled
Hazardous Waste Sites–Zone II

Environmental Protection Agency
Hazardous Site Control Division
Contract No. 68-01-7251

025851

VERTAC OFF-SITE FEASIBILITY STUDY

COMMENT DRAFT
WA 157-6P04
June 18, 1990

CH2M HILL

Black & Veatch
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Ecology and Environment

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EXECUTIVE SUMMARY

This feasibility study (FS) presents currently available sampling data and develops and evaluates remedial action alternatives for mitigating dioxin contamination in off-site areas of the Vertac Inc. site in Jacksonville, Arkansas.

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PURPOSE

The purpose of this FS is to delineate the extent of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) contamination in designated Vertac off-site areas and to provide information that will allow the U.S. Environmental Protection Agency (EPA) to determine appropriate remedial actions to protect public health and the environment.

A remedial investigation (RI) and FS were conducted previously for the Vertac off-site area. The final RI and FS reports were released in 1985 and 1986, respectively. The present FS supplements the 1985 RI by presenting sampling data collected since that RI was conducted. The present FS revises the 1986 FS. The need to revise the 1986 FS was motivated by the following developments:

- Several major sampling efforts have been conducted by Hercules Inc. (one of the potentially responsible parties, or PRPs) and EPA that further define the extent of off-site TCDD contamination.

- The Agency for Toxic Substances and Disease Registry (ATSDR) and EPA have delineated site-specific, area-specific TCDD cleanup levels.

- Remedial technologies that are potentially applicable to TCDD contamination, such as incineration, have been further developed and evaluated.

- In October 1986, Congress passed the Superfund Amendments and Reauthorization Act (SARA), which amended CERCLA and set new requirements for the Superfund RI/FS process. Chief among these new requirements is the preference for remedial actions that permanently reduce volume, toxicity, or mobility of hazardous substances, and that meet federal and state applicable or relevant and appropriate requirements (ARARs).

- In October 1988, EPA released the *Interim Final Guidance for Conducting RI/FS Studies under CERCLA*.

- Some remedial actions have been implemented in off-site areas at Vertac since 1986. Contractors for Hercules Inc. have removed some contaminated soils from developed residential areas in the Rocky Branch Creek flood plain. Access to certain contaminated areas in the Rocky Branch Creek flood plain have also been restricted by fencing.

SCOPE

Areas within the Vertac off-site investigation area that are included in the scope of this FS are:

- Wastewater collection lines between the Vertac Plant site and wastewater treatment facilities, including 10,350 feet of active lines and 4,350 feet of the abandoned Rocky Branch Creek interceptor.

- Old (abandoned) sewage treatment plant (Old STP), including clarifiers, trickling filters, sludge digester, sludge drying beds, and surface soils.

- West Wastewater Treatment Plant (West WWTP), including the 3-acre aeration basin (lagoon) and two 22-acre oxidation ponds.

- Rocky Branch Creek and Bayou Meto flood plain, including the residentially-zoned area south of the Vertac property line and north of the fork in Rocky Branch Creek.

- Rocky Branch Creek and Bayou Meto sediments.

With respect to the Creek and Bayou sediments, EPA, in conjunction with ATSDR, has determined that the TCDD levels in the Rocky Branch Creek and Bayou Meto sediments less than 2.3 ppb do not pose an unacceptable health threat (see Appendix A). In addition, EPA believes remediation of sediments to levels fully protective of aquatic and terrestrial life and for unrestricted environmental and recreational use is not feasible. Therefore, EPA plans to propose a remedy for the Creek and Bayou sediments that includes a continued ban on ingestion of fish and funding of environmental monitoring, but with no direct action for the low-level TCDD concentrations in the sediments. Consequently, remedial alternatives presented in this FS will include the above remedy for the Creek and Bayou sediments. Development and evaluation of other remedies for the sediments will not be included in this FS.

Two issues related to the Vertac site that are not included in the scope of the current FS are being addressed as part of the onsite RI/FS. These issues concern potentially contaminated groundwater and previously excavated soils that are currently stored in bags on site. Contaminated and potentially contaminated groundwater within the Vertac Plant Site is being addressed as part of the Onsite RI/FS conducted by the PRPs. Groundwater contamination found to have migrated beyond the plant site will be investigated as part of the Onsite RI/FS. Similarly, remedies to address the soils currently stored onsite will be developed and evaluated as part of the Onsite FS.

BACKGROUND

The Vertac Inc. Superfund site (Figure 1) consists of the Vertac Plant site (or onsite area) and the Vertac off-site area. Phenoxy herbicides were produced at the Vertac Plant site for more than 30 years. TCDD is an impurity formed during the production of one of those herbicides, 2,4,5-trichlorophenoxy-acetic acid (2,4,5-T). TCDD-contaminated herbicide wastes were discharged into the sewage collection lines and into Rocky Branch Creek, a small stream that flows into Bayou Meto. Subsequently, the downstream wastewater treatment facilities, and water, sediments, and flood plains of Rocky Branch Creek and Bayou Meto became contaminated with TCDD. Contamination of these areas has been confirmed by several sampling efforts in the off-site investigation area. The wastewater collection lines that are part of the off-site investigation area are shown in Figure 2.

Table 1 is a chronology of events related to contamination of the Vertac site.

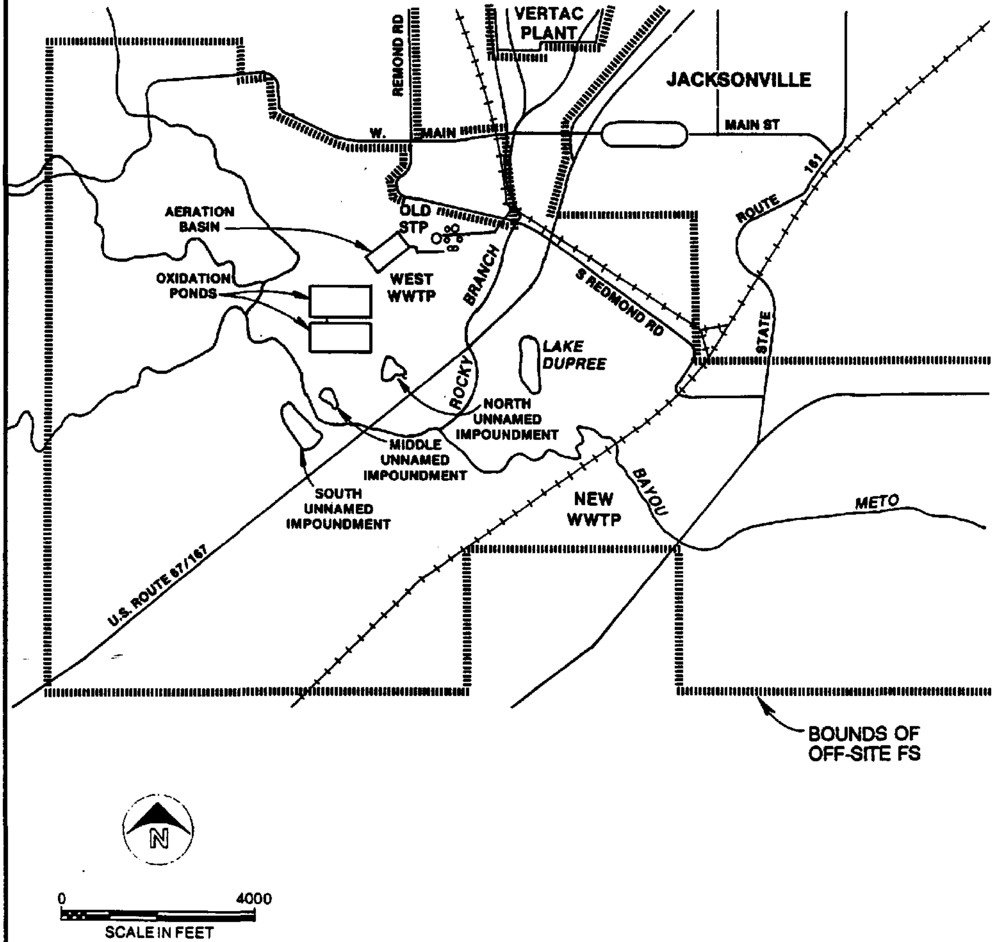

FIGURE 1

VERTAC OFF-SITE INVESTIGATION AREA

Vertac Off-Site FS
Jacksonville, Arkansas

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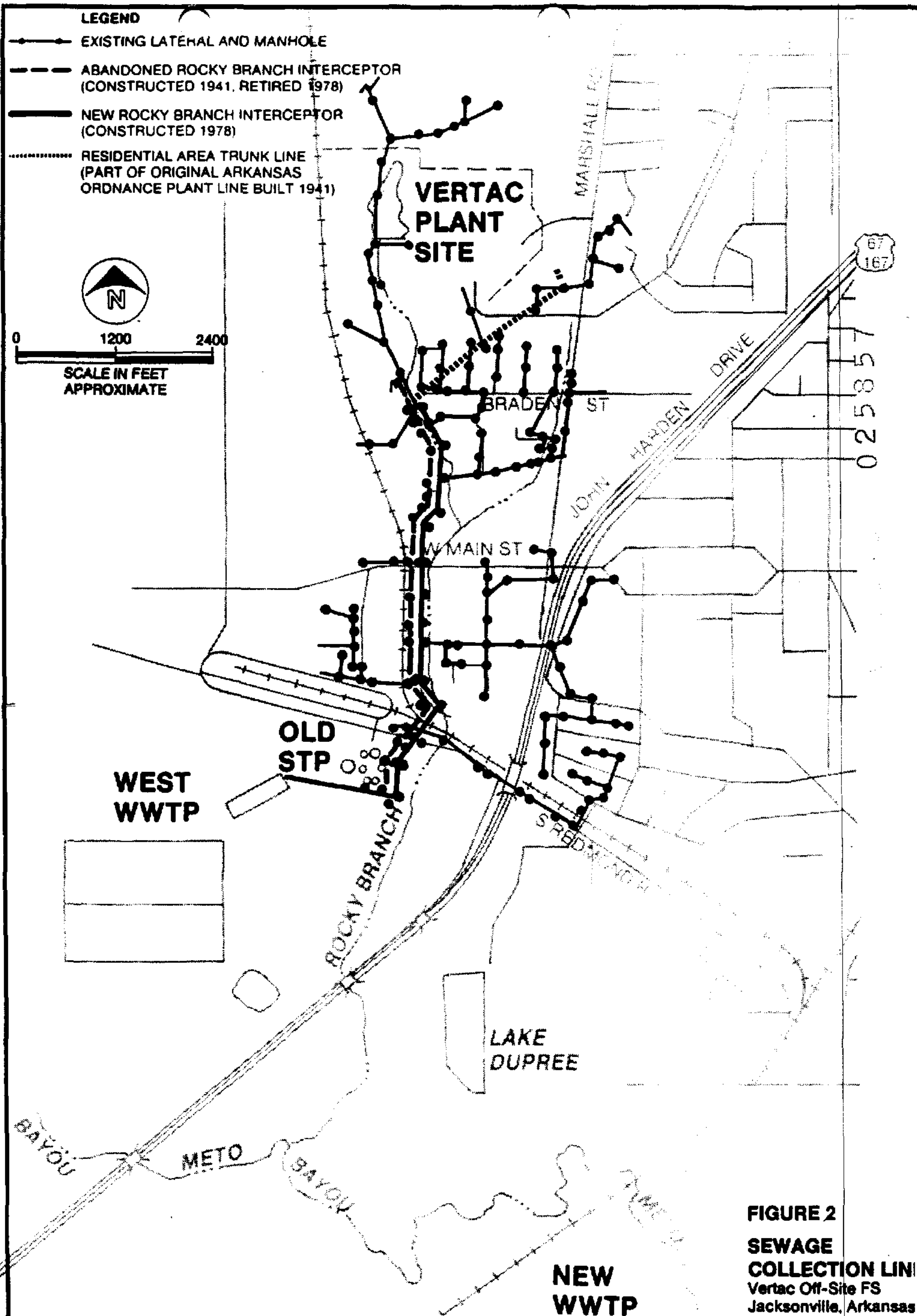

FIGURE 2

SEWAGE COLLECTION LINES
Vertac Off-Site FS
Jacksonville, Arkansas

Table 1
Chronology Of Activities At The Vertac Inc. Site (page 1 of 2)

Year(s)	Activity
1930s-40s	Arkansas Ordance Plant occupies site and produces munitions.
1941	Arkansas Ordnance Plant wastewater collection lines constructed between site and Old STP.
1948	Site purchased by Reasor-Hill Company. Pesticide production begins.
1950s	Reasor-Hill begins producing phenoxy herbicides 2,4-D, 2,4,5-TP (Silvex), and 2,4,5-T (2,3,7,8-TCDD is a contaminant formed during 2,4,5-T production).
1961	44 acres of oxidation ponds constructed. City of Jacksonville permits discharge of pesticide plant wastewater via collection lines to Old STP/oxidation ponds. Site purchased by Hercules Powder Company (now Hercules Inc.). Phenoxy herbicide production continues.
1964	Hercules builds pretreatment facility consisting of equalization and neutralization.
1967-68	Hercules produces "Agent Orange," a mixture of 2,4-D and 2,4,5-T.
1969	3-acre aeration basin constructed. Pesticide plant wastewater now conveyed to the west WWTP (aeration basin and oxidation ponds). Old STP facilities taken out of service.
1970s	Arkansas Health Department bans commercial fishing and issues advisory discouraging consumption of fish taken from Rocky Branch and Bayou Meto.
1971-76	Hercules leases plant to Transvaal Corporation. Production of 2,4-D and 2,4,5-T continues.
1978	New Rocky Branch interceptor constructed; old interceptor abandoned.
	Transvaal reorganized, through bankruptcy, into Vertac Chemical Corporation. National dioxin survey identifies Vertac site as potentially hazardous.
1979	EPA bans most uses of 2,4,5-T. Vertac ceases 2,4,5-T production but continues producing 2,4-D with same equipment (creating potential for continued TCDD contamination).

Table 1
Chronology Of Activities At The Vertac Inc. Site (page 2 of 2)

Year(s)	Activity
1980	Consent decree mandates recontainerizing thousands of pesticide waste drums, construction of barrier walls and French drains, capping landfill areas and the equalization basin.
1982	Vertac reportedly eliminates potential for cross contamination of 2,4-D by TCDD.
1983-85	RI sampling conducted in off-site area.
1984	To prevent off-site migration of contaminants from the Vertac Plant site; court orders Vertac to construct slurry walls and French drain systems, extend clay caps, and drain and fill cooling water pond on Rocky Branch.
1985	Vertac Off-site RI final report released.
1986	Vertac Off-site FS final report released
1987	Hercules sponsors sampling of off-site area. Vertac abandons site, discontinuing stabilization and drum maintenance operations. Hercules remains onsite to operate leachate collection and treatment facilities (treated wastewater discharged to West WWTP). EPA site investigation identifies approximately 28,500 leaking and deteriorated drums of pesticide waste onsite. EPA starts onsite drum management activities. Court orders Vertac and related corporate entities to place assets into receivership for environmental liabilities relating to the Vertac site contamination.
1988-89	Hercules conducts fine-grid sampling of off-site area.
	Hercules, acting on an Administrative Order on Consent, removes soil contaminated with greater than 1.0 ppb TCDD from developed residential area of Rocky Branch flood plain. EPA continues onsite waste inventories and drum management activities.
1989	Work begins on RI/FS for Vertac onsite operable units.

DATA SUMMARY

Data on TCDD concentrations in the off-site areas are available from several investigations. These investigations and the resultant data vary with respect to time, sampling protocols, and Quality Assurance/Quality Control (QA/QC) procedures. For the development of this FS, the most recent sampling data were used. Further, in areas where both grab-samples and fine-grid samples are available, data from the fine-grid sampling are used. This approach is based on the following:

- Environmental concentrations may change over time due to a variety of mechanisms, and the most recent data should be closest to current contaminant levels

- The fine-grid sampling protocol used in 1988 and 1989 generally gives results that are more representative of actual environmental concentrations than does grab sampling, which was used in previous sampling efforts

- The recent sampling efforts were subjected to more rigorous QA/QC than were earlier studies

Sediments in the wastewater collection lines have not been sampled since 1984. At that time, the active sewer lines were found to contain TCDD concentrations as high as 200 ppb (these samples were collected from the two manholes closest to the Vertac Plant site). Sediments in the abandoned Rocky Branch Creek interceptor contained TCDD concentrations as high as 70.5 ppb.

Fine-grid sampling of the Old STP grounds in 1988 indicated that the sludge-drying beds contained as high as 2.79 ppb TCDD; the soil surrounding the sludge beds contained 1.01 ppb TCDD; and soil surrounding the other facilities contained less than 1.0 ppb TCDD. Several of the Old STP treatment units were also sampled in 1984. At that time, the sludge digester contained TCDD levels as high as 12.46 ppb, the east primary clarifier contained 1.62 ppb TCDD, and the west primary clarifier contained 0.23 ppb TCDD.

Fine-grid sampling in 1988 of sediments in the West WWTP facilities found TCDD concentrations of 2.83 ppb in the southeast quadrant of the aeration basin and 1.41 ppb in the northeast quadrant of the aeration basin. Samples taken in 1988 from the western half of the aeration basin, the north and south oxidation ponds, and the outfall delta sediments in Bayou Meto found TCDD levels that were less than 1.0 ppb or nondetectable. Similarly, sediment samples from the outfall ditch in 1984 (the most recent data available) contained nondetectable levels of TCDD.

Rocky Branch Creek flood plain soils in the residentially-zoned area south of the Vertac property line and north of the fork in Rocky Branch Creek were sampled using fine-grid techniques in 1988. Sample analysis indicated that a strip of land on both sides of the west leg of Rocky Branch Creek contained TCDD in excess of 1.0 ppb, as did a drainage area just south of the Vertac property and west of the east leg of Rocky Branch Creek. Hercules Inc. has now excavated and removed soil containing greater than 1.0 ppb of TCDD from developed residential areas. This contaminated soil is now stored in plastic bags on the Vertac Plant site. However, soil containing greater than 1.0 ppb TCDD remains in undeveloped residential areas. A narrow strip of land with TCDD in excess of 1.0 ppb extends approximately 1,700 feet from the Vertac property along the west side of West Rocky Branch Creek, including a 200-foot section of soil containing as high as 9.65 ppb TCDD just south of the plant site. Another parcel of land with greater than 1.0 ppb TCDD is on the east side of West Rocky Branch Creek extending approximately 1,300 feet north from the confluence of the east and west legs of Rocky Branch Creek. (The soil north of this land to the Vertac property was excavated previously.)

All other areas of the Rocky Branch Creek and Bayou Meto flood plains sampled during the 1988 fine-grid sampling showed TCDD levels that were nondetectable or less than 1.0 ppb.

Only two sediment samples from Rocky Branch Creek and Bayou Meto showed concentrations greater than 1.0 ppb TCDD. A composite sample taken in 1988 on the west leg of Rocky Branch Creek between zero and 500 feet from the confluence of the east and west legs showed a TCDD concentration of 2.3 ppb. A 1987 grab sample taken by Hercules showed a concentration of 1.2 ppb at the confluence of the West WWTP outfall and Bayou Meto

QUANTITY OF MATERIAL REQUIRING REMEDIATION

The volume of material considered for remediation was estimated based on the most recent sampling data and the area-specific TCDD action levels recommended by the ATSDR to EPA. These levels are described below. Table 2 lists estimated volumes of material considered for remediation.

TARGET CLEANUP AREAS AND ACTION LEVELS

ATSDR reviewed the 1985 Vertac Off-site RI Report and assessed the human health significance of the contamination and the need for off-site cleanup. Based on their evaluation, ATSDR developed guidelines and criteria for remediation of TCDD-contaminated materials in the Vertac off-site area. The following levels were derived from the 1989 memorandum from EPA to ATSDR (Appendix A) and ATSDR recommendations (Appendix B).

Table 2
Volumes Of Material Considered for Remediation

Area	Volume
Sewage Collection Lines	
Sediment in active lines	10 cubic yards
Soil surrounding active lines	7,700 cubic yards
Abandoned Rocky Branch interceptor and surrounding soil	3,200 cubic yards
Old STP	
Sludge in sludge digester	890 cubic yards
Soil in sludge-drying beds and surrounding soil	1,500 cubic yards
Sediment in primary clarifiers	90 cubic yards
Water in primary clarifiers	126,000 gallons
West WWTP	
Sediment in aeration basin	8,000 cubic yards
Water in aeration basin	6.8 million gallons
Sediment in oxidation ponds	208,000 cubic yards
Water in oxidation ponds	30 million gallons
Rocky Branch Creek and Bayou Meto Flood Plain	
Soil in undeveloped residential area owned by Hercules Inc. (1.0 ppb <TCDD <5.0 ppb)	2,100 cubic yards
Soil in undeveloped residential area west of W. Rocky Branch and immediately south of Vertac property (TCDD >5.0 ppb)	400 cubic yards
Soil in undeveloped residential area west of W. Rocky Branch (1.0 ppb <TCDD <5.0 ppb)	1,600 cubic yards

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- **Wastewater Collection System.** The sewer lines that were indicated in the RI to have TCDD concentrations equal to or greater than 1.0 ppb need to be remediated. This action level was chosen because the contaminants in the sewer line could migrate downstream and contaminate the wastewater treatment facilities, Bayou Meto, and nearby flood plains.

- **Old Sewage Treatment Plant.** TCDD-contaminated sludges, wastes, soils, and sediments in the abandoned facilities require remediation so that an action level of 5.0 ppb TCDD is not exceeded. The ATSDR recommended an action level of 5 to 7 ppb TCDD for soils in and around the abandoned sewage treatment facilities if the following conditions were imposed:

  - The site must not be developed for agricultural or residential use.

  - The use and activities at the site must not become associated with the production, preparation, handling, consumption, or storage of food, other consumable items, or food-packaging materials.

  - The site soils must be protected from erosion that would uncover or transport TCDD that could cause unacceptable human exposure at a future date.

- **West Wastewater Treatment Plant.** An action level of 5 to 7 ppb was recommended for the aeration basin, oxidation ponds, outfall ditch, and peripheral land zoned for manufacturing. This action level is subject to the same conditions listed above for the Old STP.

- **Flood Plain--Residential and Agricultural.** An action level of 1.0 ppb TCDD would be adopted for residential and agricultural areas.

- **Flood Plain--Nonresidential and Nonagricultural.** Nonresidential and nonagricultural areas in the flood plain (such as woodlands, industrial, and commercial areas) that are not subject to erosion and transport processes would have an action level of 5.0 ppb TCDD. If the areas are subject to erosion and transport processes (lack sufficient ground cover to inhibit erosion), the action level would be 1.0 ppb.

- **Rocky Branch and Bayou Meto Sediments.** Assuming a continued and effective State advisory against ingestion of fish, the 0.3 to 2.3 ppb levels of TCDD in the sediments should not pose an unacceptable health threat. The action level for the sediments is, therefore, 2.3 ppb.

IDENTIFICATION AND SCREENING OF TECHNOLOGIES

EPA's *Guidance for Conducting RI/FS Studies under CERCLA* (EPA, 1988) includes the following stepwise process for identifying and screening technologies:

- Establish remedial action objectives

- Identify general response actions and remedial technologies for each medium of interest

- Identify process options for the various remedial technologies, and screen technologies/options based on technical implementability

- Evaluate remaining process options based on effectiveness, institutional implementability, and relative cost

- Select one or more remedial technologies/process options to represent the various technology types in assembling site wide remedial action alternatives designed to meet site objectives

The remedial action objectives identified for the Vertac off-site area are:

1. For residential and agricultural areas, prevent long-term ingestion of contaminated soils with TCDD concentrations above 1.0 ppb.

2. For nonresidential/nonagricultural or undeveloped residential areas (Old STP, West WWTP, undeveloped Rocky Branch Creek flood plain areas), prevent direct public contact with contaminated soils containing TCDD concentrations above 1.0 ppb. For the Old STP and West WWTP, this action level is 1.0 rather than 5 to 7 ppb as recommended by ATSDR due to concerns about people using the sludge drying beds for gardening and safety concerns if water is left in clarifiers.

3. Prevent migration of TCDD-contaminated sediments into the waterways and surrounding flood plains.

4. Prevent migration of TCDD-contaminated sediments through the sewage collection lines to the new Jacksonville sewage treatment facility.

5. Implement EPA and ATSDR recommendations for Rocky Branch Creek and Bayou Meto sediments.

After identifying an extensive list of general response actions/remedial technologies/ process options, the screening and evaluation steps were performed. A much shorter list of representative remedial technologies and process options was selected for the development of alternatives. These are shown in Table 3.

DEVELOPMENT OF ALTERNATIVES

Using the remedial technologies and process options selected to represent the various technology types, six sitewide remedial action alternatives were assembled. These alternatives represent a range in the extent of remediation. These alternatives are summarized below.

Alternative 1

- No further action would be taken to prevent human exposure to contaminated materials, to prevent contaminant migration, or to protect the environment. However, the current institutional controls would continue.

- Rocky Branch Creek and Bayou Meto Stream Sediments--No action, and continued ban on fishing.

Alternative 2

- Collection Lines--Sediments would be removed from the active sewage collection lines between the Vertac Plant site and the West WWTP. This sediment would be incinerated onsite. No action would be taken on the abandoned Rocky Branch Creek interceptor line.

Table 3
Representative Remedial Technologies And Process Options Selected For Use In Assembling Sitewide Remedial Action Alternatives

General Response Action	Remedial Technology	Process Option	Pertinent Area(s)
Institutional controls	Access and use restrictions	Deed Restrictions Fences, Signs	d,f b,c,d,f
Containment	Capping	Soil cap Asphaltic concrete Multilayered cap	b b b,c,d,e
Removal	Solids removal Demolition	Soil Sludge Sediment Construction equipment	b,d b,c a,b,c b
Treatment	Soils dewatering Thermal treatment	Filter press Incineration	a,b,c a,b,c,d
Disposal	Landfill	Onsite consolidation	b,d
Monitoring	Monitoring	Fish and wildlife monitoring	f

Note: a = Sewage collection lines
b = Old STP
c = West WWTP
d = Rocky Branch Creek and Bayou Meto flood plain
e = Onsite consolidation area
f = Bayou Meto and Rocky Branch Creek sediments

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- Old STP--The sludge would be removed from the sludge digester and consolidated onsite (on the Vertac Plant site) and capped. No action would be taken on the other STP units. Deed notices would be placed restricting access and use.

- West WWTP--Public access and use of the West WWTP grounds and facilities would be restricted.

- Rocky Branch Creek and Bayou Meto Flood Plain--Soils with TCDD levels greater than 1.0 ppb have previously been removed from developed residential areas. In nonresidential, nonagricultural, and undeveloped residential areas with TCDD levels between 1.0 and 5.0 ppb, access and use would be restricted; in those areas with TCDD greater than 5.0 ppb, soils would be removed, consolidated onsite, and capped.

- Rocky Branch Creek and Bayou Meto Stream Sediments--No action, and continued advisory against ingestion of fish.

Alternative 3

- Collection Lines--Sediments would be removed from the active sewage collection lines between the Vertac Plant site and the West WWTP and incinerated. Pipe liners would be installed in the cleaned sewer lines. No action would be taken on the abandoned Rocky Branch Creek interceptor line.

- Old STP--The sludge would be removed from the sludge digester and incinerated. The sludge drying beds would be paved with an asphalt cap. No action would be taken on the other STP units. Access and use of other areas of the Old STP grounds would be restricted.

- West WWTP--The oxidation ponds would be flood protected, by berming, against inundation during the 100-year flood. Access and use of the West WWTP facilities would be restricted.

- Rocky Branch Creek and Bayou Meto Flood Plain--In nonresidential, nonagricultural, and undeveloped residential areas with TCDD levels between 1.0 and 5.0 ppb, access and use would be restricted; in those areas with TCDD greater than 5.0 ppb, soils would be removed and incinerated onsite.

- Rocky Branch Creek and Bayou Meto Stream Sediments--No action, and continued ban on fishing.

Alternative 4

- Collection Lines--Sediments would be removed from the active sewage collection lines between the Vertac Plant site and the West WWTP and incinerated. Pipe liners would be installed in the cleaned sewer lines. The abandoned Rocky Branch Creek interceptor would be removed and incinerated.

- Old STP--The sludge would be removed from the sludge digester and incinerated. Likewise, the sludge drying beds would be excavated and the material incinerated. No action would be taken on the other STP units. Access and use of the Old STP grounds would be restricted.

- West WWTP--The aeration basin would be dewatered, allowed to dry, and covered with a soil/vegetation cap. The oxidation ponds would be flood protected by berming against inundation during the 100-year flood. Access and use of the West WWTP grounds would be restricted.

- Rocky Branch Creek and Bayou Meto Flood Plain--Soil with TCDD levels greater than 1.0 ppb would be removed from all residential areas (developed or undeveloped) and incinerated.

- Rocky Branch Creek and Bayou Meto Stream Sediments--No action, and continued ban on fishing.

Alternative 5

- Collection Lines--The sewage collection lines (active and abandoned) running between the Vertac Plant site and the West WWTP and the soil surrounding the lines would be removed and incinerated. New sewer lines would be constructed.

- Old STP--The sludge would be removed from the sludge digester and incinerated. The sludge drying beds would be excavated and incinerated. The material would be removed from the primary clarifiers; the water would be treated and the sediment would be incinerated. No action would be taken on the other STP units. Access and use of the Old STP grounds would be restricted.

- West WWTP--The aeration basin sediments would be removed and incinerated. The oxidation ponds would be dewatered, allowed to dry, and covered with a soil/vegetation cap. The water removed from the aeration basin and oxidation ponds would be treated by sedimentation/filtration/carbon adsorption. Access and use of the West WWTP grounds would be restricted.

- Rocky Branch Creek and Bayou Meto Flood Plain--Soil with TCDD levels greater than 1.0 ppb would be removed and incinerated.

- Rocky Branch Creek and Bayou Meto Stream Sediments--No action, and continued ban on fishing.

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Alternatives 6a and 6b

- Collection Lines--Sediments would be removed from the active sewage collection lines between the Vertac plant site and the West WWTP and incinerated. Pipe liners would be installed in the cleaned sewer lines. Abandoned line would be filled with grout.

- Old STP--The sludge would be removed from the sludge digester and incinerated. The sludge drying beds would be covered with 1 foot of clean soil. Accumulated water in treatment units would be removed, and the treatment units would be demolished and buried onsite with 1 foot of clean soil cover. A notice restricting access and development would be put in the deed.

- West WWTP--The aeration basin would be dewatered, the dikes demolished, and the entire basin covered with 1 foot of clean soil. A notice restricting access and use would be placed in the deed. The oxidation ponds would not be bermed against the 100-year flood in Alternative 6. In recent discussions with ATSDR (May 1990), ATSDR informed EPA that the original recommendation to berm the ponds was based on 1984 data that showed concentrations up to 3.6 ppb TCDD. ATSDR informed EPA that, since the 1988 fine-grid sampling showed TCDD concentrations not exceeding 0.97 ppb TCDD, berming of the ponds was not necessary.

- Rocky Branch Creek and Bayou Meto Flood Plain--Soil with TCDD levels greater than 1.0 ppb would be removed from all areas and either incinerated (6a) or consolidated onsite (6b).

- Rocky Branch Creek and Bayou Meto Stream Sediments--No action, and continued ban on fishing.

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Section 1

Introduction

Section 1
INTRODUCTION

PURPOSE

This feasibility study (FS) is intended to provide information for the U.S. Environmental Protection Agency (EPA) to determine appropriate actions to remediate threats or potential threats to public health and the environment from designated Vertac off-site areas in Jacksonville, Arkansas.

There has been previous EPA documentation on the extent of contamination and possible remedial alternatives for potential threats from contamination in the Vertac off-site area. This documentation includes the December 1985 Vertac Off-site Remedial Investigation (RI) Report and the June 1986 Vertac Off-site FS. However, several developments since the June 1986 report have created a need to revise those documents. These developments include the following:

- Several major sampling efforts have been conducted by Hercules Inc. (one of the potentially responsible parties, or PRPs) and EPA that further define the extent of off-site contamination by 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD).

- The Agency for Toxic Substances and Disease Registry (ATSDR) and EPA have delineated site-specific, area-specific TCDD cleanup levels.

- Remedial technologies that are potentially applicable to TCDD contamination, such as incineration, have been further developed and evaluated.

- In October 1986, Congress passed the Superfund Amendments and Reauthorization Act (SARA), which amended the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and set new requirements for the Superfund RI/FS process. Chief among these new requirements is the preference for remedial actions that permanently reduce volume, toxicity, or mobility of hazardous substances and that meet federal and state ARARs.

- In October 1988, EPA released the *Interim Final Guidance for Conducting RI/FS Studies under CERCLA*.

- Some remedial actions have been implemented in off-site areas at Vertac since 1986. Contractors for Hercules Inc. have removed some contaminated soils from developed residential areas in the Rocky Branch Creek flood plain. Access to certain contaminated areas in the Rocky Branch Creek flood plain has also been restricted by fencing.

As a result of these developments, EPA has determined that the 1986 Vertac off-site FS should be revised and updated to consider the most currently available data and to reflect the requirements of SARA.

This revised FS report is intended to:

- Provide an overview of TCDD data gathered since 1986 and refine the assessment of the extent of contamination using current EPA guidance and ATSDR recommendations for TCDD cleanup levels

- Revise the 1986 FS to:
  - address the extent of contamination in each site area as indicated by the additional data
  - be in substantive compliance with the requirements of SARA
- Develop and evaluate remedial alternatives in the FS to reflect new remedial technologies and the current state of development for the remedial technologies considered

SCOPE OF STUDY

This FS for the Vertac off-site area revises the previously released Vertac Off-site Feasibility Study final report (June 1986). Table 1-1 summarizes the scopes of the current and 1986 feasibility studies. Both studies focused on TCDD as the contaminant of concern.

The off-site study area is shown in Figure 1-1. The specific areas included in the scope of this study are:

- **Wastewater Collection Lines.** Included are approximately 10,350 linear feet of the active Rocky Branch Creek interceptor collection system and approximately 4,350 linear feet of the abandoned Rocky Branch Creek interceptor collection system. Both of these systems received wastewater from the pesticide plant that generated TCDD (see "Site Description and History" in Section 2) and discharged into the Old Sewage Treatment

Table 1-1
Comparison of Scope:
1986 Versus Current Vertac Off-Site FS

Off-Site Areas	1986 FS	Current FS (1989)	Comments
Wastewater Collection System	Included	Included	No new RI data since 1985
Old Sewage Treatment Plant	Included	Included	Recent RI data included in current FS
West Wastewater Treatment Plant	Included	Included	Recent RI data included in current FS
Rocky Branch Creek Flood Plain	Included	Included	Recent RI data included in current FS
Bayou Meto Flood Plain	Included	Included	Recent RI data in current FS; previous RI data sparse
Banks and in-stream sediments of Bayou Meto and Rocky Branch Creek	Included	Included	Recent RI data in current FS; previous RI data sparse
Other Issues			
Groundwater contamination	Not included[a]	Not included[a]	No new RI data since 1985
Non-TCDD contamination	Not included[b]	Not included	Limited recent RI data

[a]Potential groundwater contamination is being addressed as part of the Onsite FS.
[b]Previous studies indicated contaminants other than TCDD in the investigation areas, such as 2,4-D, 2,4,5-T, 2,4,5-TP, chlorinated benzenes, and chlorinated phenols. The RI concentrated on TCDD because it is considered the most hazardous contaminant in the area, and remediation for TCDD is presumed to remediate other contamination problems.

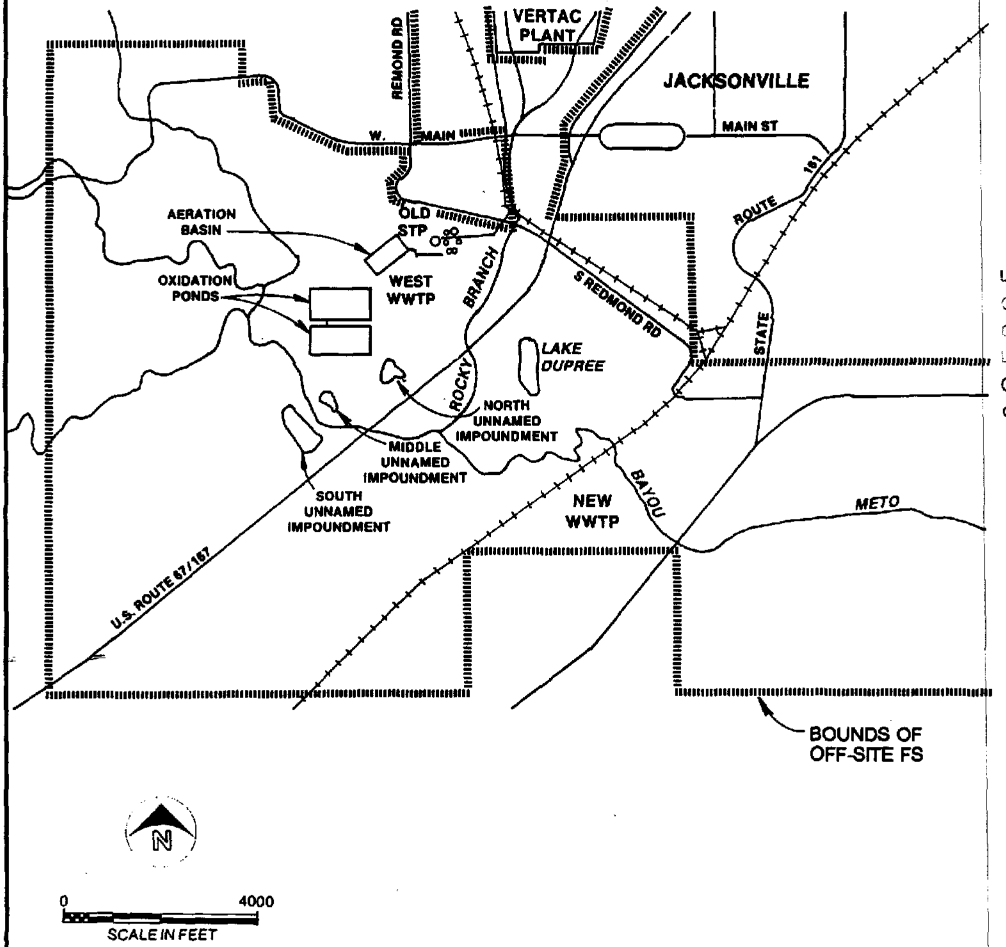

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FIGURE 1-1

VERTAC OFF-SITE INVESTIGATION AREA

Vertac Off-Site FS
Jacksonville, Arkansas

Plant (now abandoned) and the West Wastewater Treatment Plant. The active Rocky Branch Creek interceptor system currently receives wastewater discharges from the on-site Vertac leachate treatment system and sanitary and stormwater discharges from limited residential, commercial, and industrial areas. These combined wastes are currently discharged into the West Wastewater Treatment Plant.

- **Old (Abandoned) Sewage Treatment Plant.** Included are treatment units (clarifiers, trickling filters, sludge digester, sludge drying beds) and surrounding plant surficial soils. In addition to municipal wastewater, the Old Sewage Treatment Plant received wastewater from the pesticide plant through the Rocky Branch Interceptor from 1948 until 1961.

- **West Wastewater Treatment Plant.** Included are a 3-acre aeration basin and two 22-acre oxidation ponds. The West Wastewater Treatment Plant received wastewater from the pesticide plant through the Rocky Branch Creek interceptor from 1961 until 1987, when Vertac ceased operations. Currently, treated wastewater from the Vertac onsite leachate treatment system is discharged through the Rocky Branch Creek interceptor to the West Wastewater Treatment Plant.

- **Rocky Branch Creek and Bayou Meto Flood Plain.** Included are Rocky Branch Creek flood plain soils and soils in the flood plain of Bayou Meto. Soils on currently developed residential properties found to contain TCDD concentrations greater than 1.0 parts per billion (ppb) in the 1988 fine-grid sampling investigation were removed in emergency response actions and are temporarily stored in bags on the Vertac Plant site. Some TCDD-contaminated soils excavated within the Vertac property line are also stored in bags on the plant site.

- **Rocky Branch Creek and Bayou Meto Stream Sediments.** Included are the Rocky Branch Creek and Bayou Meto sediments. EPA and ATSDR have determined that the up to 2.3 ppb TCDD levels found in the sediments do not pose an unacceptable health threat assuming a continued and effective state advisory discouraging ingestion of fish taken from the affected areas (see Appendix A).

The following are not included in the scope of this study:

- **Groundwater.** Potential groundwater contamination was not included in the 1986 Off-site FS and is not included in this FS. Potential groundwater contamination is being addressed as part of the Onsite RI/FS. Groundwater contamination found to have migrated beyond the Vertac plant site will be investigated as part of the onsite investigation.

- **Non-TCDD Contaminants.** Previous studies indicated contaminants other than TCDD exist in the investigation areas, such as 2,4-D, 2,4,5-T, 2,4,5-TP, chlorinated benzenes, and chlorinated phenols. The 1985 RI and recent site investigations have concentrated on TCDD because it is considered the most hazardous contaminant in the area, and remediation for TCDD is presumed to remediate most other contamination problems.

- **Bagged Onsite Soils.** Soils removed from residential properties and excavated onsite soils currently stored in bags on the plant site are not within the scope of the Off-site FS. These bagged soils will be addressed during the Onsite RI/FS.

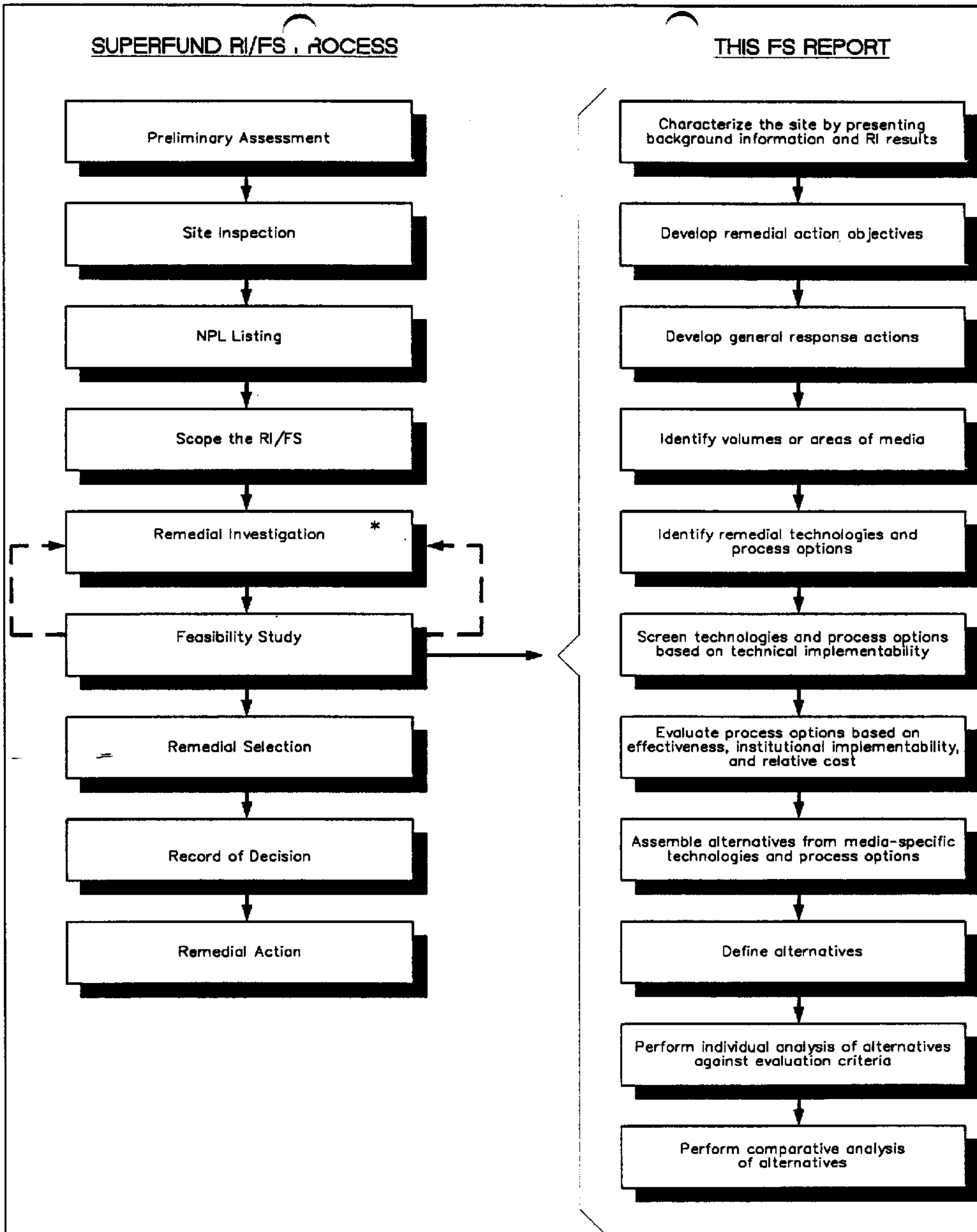
This FS provides a wide range of technical and site-specific information for evaluating alternative remedial actions for the Vertac off-site area. The technologies assumed in the remedial alternatives are representative technologies presented to allow comparative evaluations and cost estimates. Several assumptions were made in developing alternatives. These assumptions included waste incinerability parameters, soil and sludge moisture contents, extent to which sludges could be dewatered, water treatment requirements, and schedules for remedial action.

ORGANIZATION

Figure 1-2 shows the major steps in the overall RI/FS process and the portion of the process covered in this report. The content and organization of this report closely follows the procedure described in the *Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA, October 1988).

SUPERFUND PROCESS

CERCLA as amended by SARA requires that the EPA establish procedures to ensure that the Hazardous Substance Response Trust Fund (commonly known as Superfund) be used as effectively as possible in responding to releases of hazardous substances in the environment. In accordance with CERCLA, the EPA has established a process for discovering releases, conducting site investigations, developing and evaluating site remedial action alternatives, and selecting site remedial actions. This process is commonly referred to as the RI/FS process.



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* Supplemental Vertac Off-Site RI data are summarized in this FS report.

FIGURE 1-2

THE FEASIBILITY STUDY PROCESS

Vertac Off-Site FS
Jacksonville, Arkansas

J:\INDUST\DEN69071\FIGURE-4.DWG

SARA was signed by the President on October 17, 1986, to amend CERCLA. While SARA did not change the basic structure of CERCLA, it did modify many of the existing requirements and added new ones. References made to CERCLA throughout this document should be interpreted as meaning "CERCLA as amended by SARA."

Section 2

Background

Section 2
BACKGROUND

The Vertac, Inc., NPL site is in Jacksonville, Arkansas, northeast of Little Rock, and consists of the Vertac Plant site and the Vertac off-site area (Figure 2-1). This section provides background information relevant to the contamination of the Vertac site by TCDD and includes the following information:

- Site Description and History--summarizes site characteristics, events leading to environmental contamination, and existing remedial measures.

- Nature and Extent of Off-site Contamination--describes the various sampling events and summarizes the most recent data available for the off-site investigation areas. Where data are comparable, they are compared to determine if any historical trends are identifiable. Appendixes are also provided to present a more comprehensive summary of sampling data for each off-site area. Estimates of the quantity of material requiring remediation are tabulated.

- Target Cleanup Areas and Action Levels--describes those areas and the levels recommended by ATSDR and EPA.

- Endangerment Assessment--discusses the potential routes of contaminant migration and exposure to contaminants identified in the 1986 Endangerment Assessment (U.S. EPA, June 1986). This subsection also provides an updated estimate of the risks posed by ingestion of TCDD-contaminated soil.

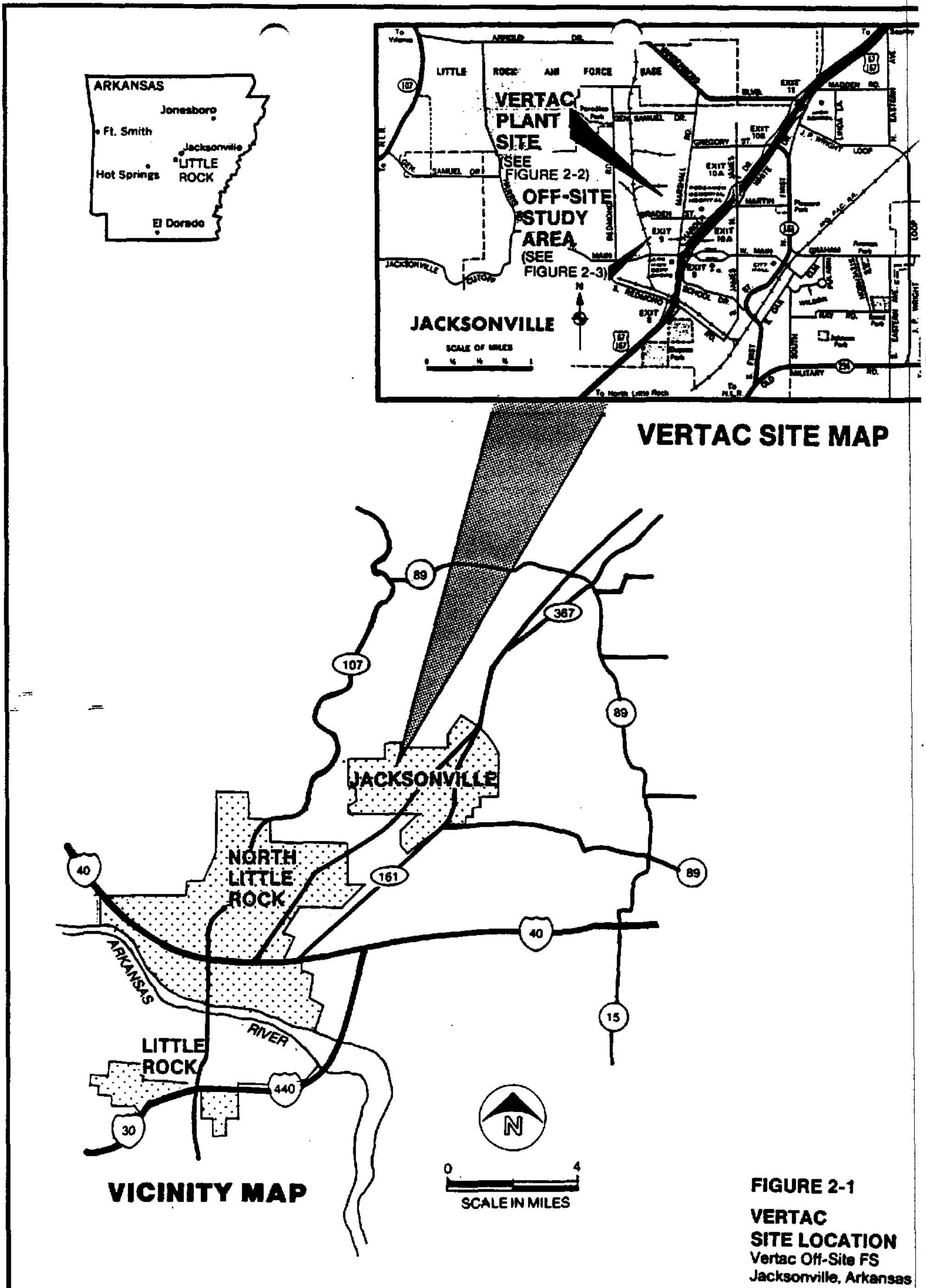


FIGURE 2-1

VERTAC
SITE LOCATION
Vertac Off-Site FS
Jacksonville, Arkansas

025893

SITE DESCRIPTION AND HISTORY

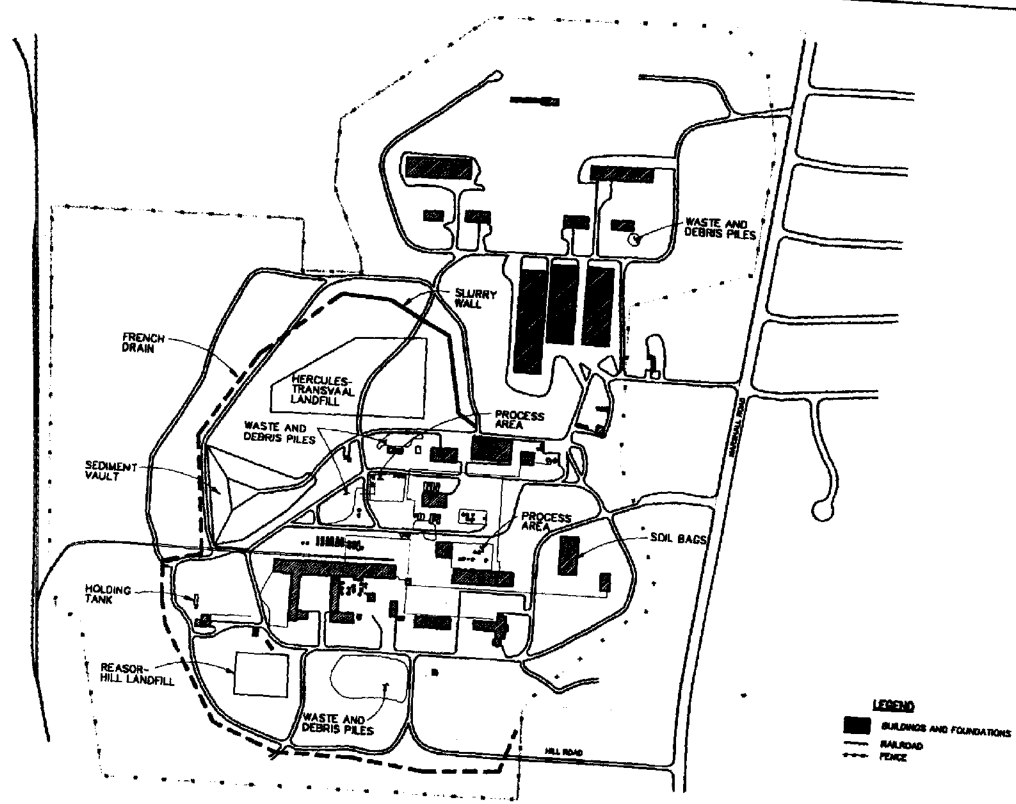
VERTAC PLANT SITE

The first company to manufacture pesticides at the location of what is now the Vertac site (Figure 2-2) was the Reasor-Hill Company, which purchased the site in 1948. Hercules bought the facility from Reasor-Hill in 1963 and operated the plant until 1971. From 1971 to 1976, Transvaal leased the plant from Hercules. Transvaal purchased the site in 1976 and reorganized into Vertac. The plant was operated by Vertac until January 1987.

From 1950 to 1987, the primary products of the plant under each operator were the herbicides 2,4,5-T and 2,4-D. An unwanted by-product of the manufacturing process of 2,4,5-T is 2,3,7,8-tetrachlorodibenzo-p-dioxin, which is considered to be a probable human carcinogen, a teratogen, and possibly a mutagen, based on animal studies.

Attention was first focused on the Vertac plant after the National Dioxin Survey in 1978. Samples of production wastes collected during the survey were found to contain TCDD in concentrations as high as 40 parts per million (ppm). As a result of these findings, EPA and ADPC&E began environmental investigations at the site that resulted in the site being placed on the NPL in 1979.

ADPC&E issued an order in 1979 that required Vertac, Inc., to improve their hazardous waste practices, and in 1980 EPA and ADPC&E jointly filed suit in federal district court against Vertac, Inc., and Hercules, Inc. A Consent Decree entered into by EPA, ADPC&E, Vertac, and Hercules in January 1982 required an independent consultant to assess the conditions of onsite wastes and to develop a proposed disposal method for the wastes. The proposal, called the "Vertac Remedy," was deemed by



SITE PLAN

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FIGURE 2-2

EPA to be unsatisfactory and EPA returned to court in early 1984 for a resolution. The court decided in favor of the proposed remedy, which was implemented in the summer of 1984 and completed in July 1986.

As part of the remedy, the Vertac plant cooling water pond and the equalization basin were closed and sediments from these units were removed and placed into the sediment vault. The burial area was capped and a French drain and leachate collection system were installed around the burial areas. Groundwater monitoring wells were also installed and a groundwater monitoring program was initiated. The remedy did not address: 1) drums of still bottom wastes from the manufacturing process stored onsite or 2) contaminated process equipment, surface soils, and buildings.

Under a stipulation entered into with Vertac in 1986, EPA and ADPC&E agreed not to contest the transfer of certain Vertac operations in exchange for Vertac establishing a $6.7 million environmental trust fund and a $4 million environmental letter of credit for environmental remediation. In January 1987, Vertac announced that the company did not have the fiscal resources to implement further remedial actions and abandoned the site. Vertac's shareholders attempted to transfer Vertac assets to another company under the same management, but the United States challenged the transfer and a receiver was appointed for Vertac.

Approximately 28,300 drums of production still bottom wastes were left on the site at the time. Some of these wastes have been found to consist of various toluenes and phenols contaminated with dioxin concentrations as high as 50 ppm. There had been widespread failures of both metal and plastic drums due to the corrosivity of the wastes (pH<3) and ultraviolet degradation of the drums. In February 1987, an immediate removal action was initiated to mitigate the hazards posed by the deteriorating drums. Between that time and February 1989, drums were overpacked and spilled material containerized as interim measures to minimize hazards until a permanent remedy could be implemented.

In 1989, ADPC&E signed a contract to have the 28,500 barrels of waste incinerated onsite. The state used the $10.7 million trust fund to finance the project. Incineration of these wastes is scheduled to begin in the fall of 1990.

Currently, there are several distinct but related remedial actions being conducted at the Vertac site. These include:

- State-led incineration of onsite drums
- Hercules-led onsite RI/FS
- EPA-led off-site RI/FS

The off-site FS is being conducted to address offsite contamination, including contamination of surface soils, Rocky Branch Creek, Bayou Meto, the Old STP, and West WWTP. In response to an Administrative Order in 1988, Hercules, Inc. has excavated soil in the area of four residences south of the site that were contaminated above the action level of 1.0 ppb. The excavated soil is being stored on Vertac property (EPA, 1989). The excavated soil, contaminated process equipment, surface soils, buildings, and wastes in storage tanks onsite are being addressed in the onsite RI/FS.

This document addresses the FS for the off-site areas.

OFF-SITE INVESTIGATION AREA

Site Description

The Vertac off-site investigation area is shown in Figure 2-3. Surface runoff from the Vertac Plant site flows into Rocky Branch Creek, which flows into Bayou Meto, a larger watercourse that flows into the Arkansas River. Currently, Hercules operates an onsite system that collects and treats initial site runoff prior to discharge to Rocky Branch Creek. The treatment system consists of pH reduction, filtration, carbon adsorption, and pH neutralization. This system treats collected liquids from the french drain system as well as surface runoff. Four sumps, with a total capacity of over 6,000 gallons, are used to collect initial runoff prior to treatment.

The pesticide plant and adjacent residential, commercial, and industrial areas are served by a sanitary and storm sewerage system (Figure 2-4). The sewage collection lines conveyed wastewater to the Old Sewage Treatment Plant (Old STP) until 1969, when the original facilities were abandoned. The Old STP discharged treated effluent to Rocky Branch Creek until 1961, when the Old STP was upgraded. The upgrade added a sludge digester, sludge-drying beds, and 44 acres of oxidation ponds to the existing unit operations (two trickling filters, two primary clarifiers, and two secondary clarifiers). Since 1961, treated wastewater effluent has been discharged directly to Bayou Meto. Because of an organic overload to the system due in part to pesticide wastes from the Vertac Plant site, a 3-acre aerated lagoon was constructed in 1969. At that time, the original Old STP facilities were abandoned.

Influent wastewater is now conveyed directly to the aeration basin and treatment occurs in the aeration basin and oxidation ponds, collectively referred to as the West Wastewater Treatment Plant (West WWTP).

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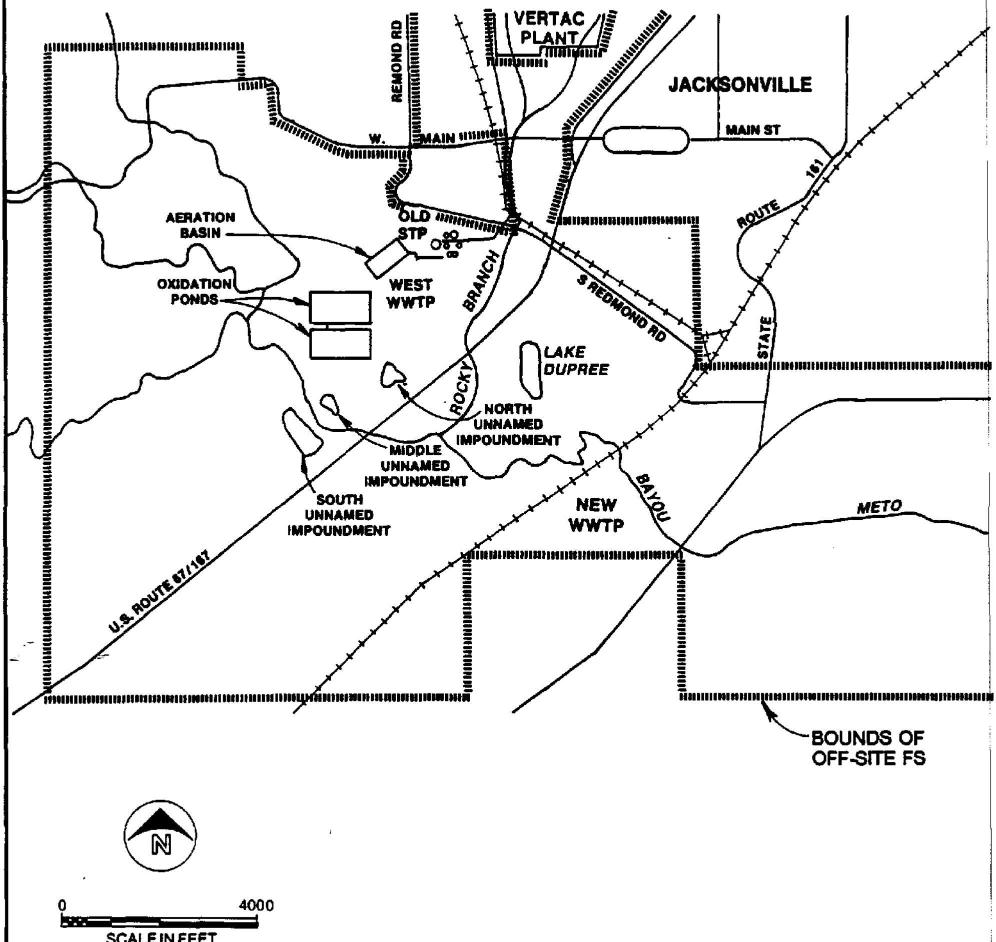

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FIGURE 2-3

VERTAC OFF-SITE INVESTIGATION AREA
Vertac Off-Site FS
Jacksonville, Arkansas

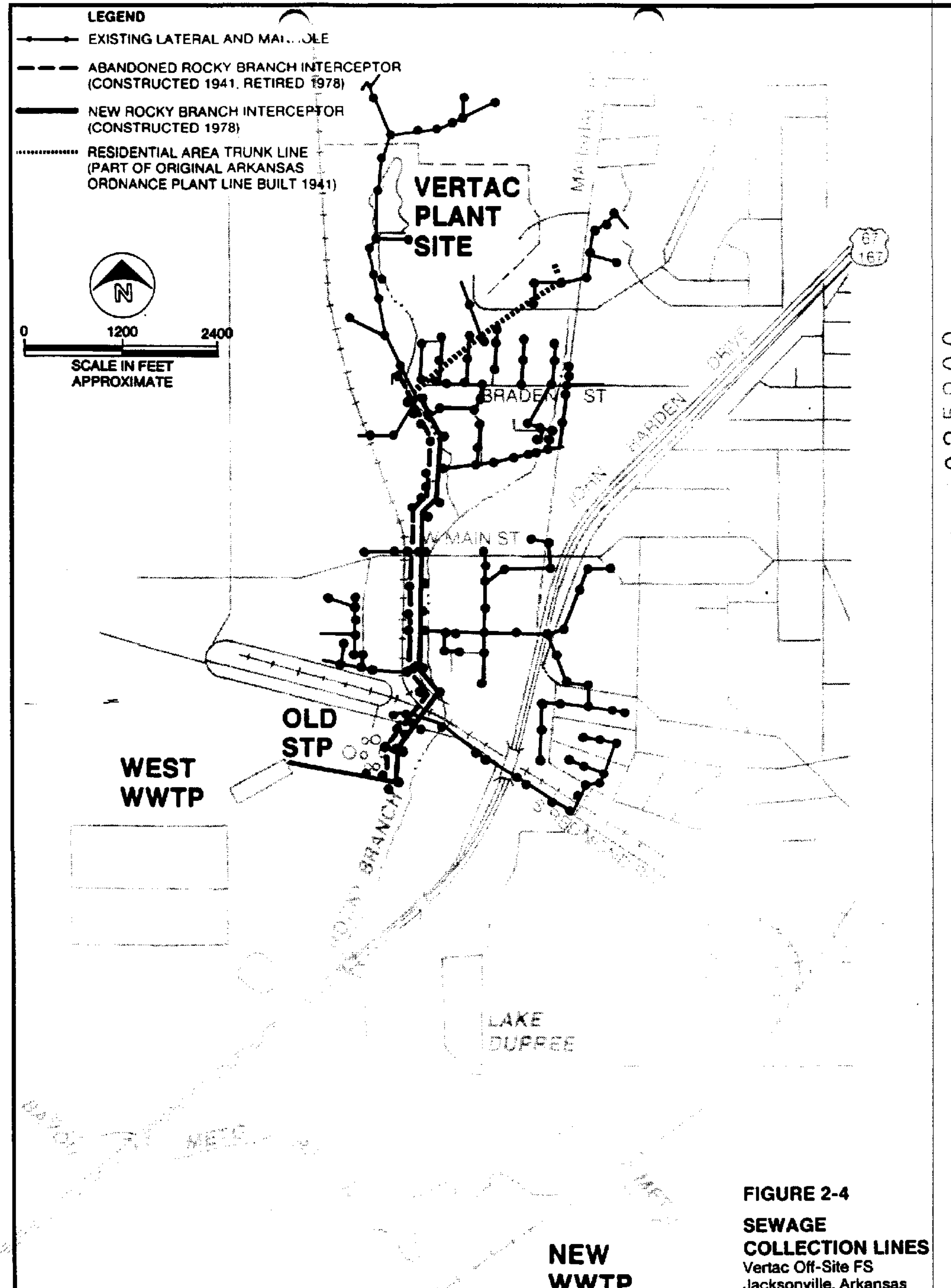

FIGURE 2-4

SEWAGE COLLECTION LINES

Vertac Off-Site FS

Jacksonville, Arkansas

025900

A new EPA-funded wastewater treatment plant has been constructed for the City of Jacksonville (see Figure 2-3). This facility treats Jacksonville municipal wastewater and is intended to treat sewage currently conveyed to the West WWTP. However, the federal construction grant stipulates that the new plant not receive TCDD-contaminated waste. Before the collection lines serving residences south of the Vertac Plant site can be connected to the new wastewater treatment plant, the lines must be cleaned or replaced.

Sources of Off-Site Contamination

Release of TCDD-contaminants to off-site areas probably dates back to 1948, when pesticide production began, and became more substantial during production of Agent Orange in the 1960s.

The Arkansas Ordnance Plant sewer lines were constructed in 1941 and were in operation when Reasor-Hill purchased the plant. During the Reasor-Hill period, it is likely that pesticide wastes were continuously discharged into the sewer lines and into Rocky Branch Creek. Stormwater runoff and flooding probably have contributed to migration of contaminants from the Vertac Plant site to off-site areas.

Although arrangements to treat pesticide wastes were not formalized until 1961, it is likely that earlier operational problems in the Old STP were caused by discharges from the pesticide plant. A process waste outfall line was constructed in 1961 to convey plant wastes to the Rocky Branch Creek interceptor, the main line of the area's sewage collection system. Pretreatment of the process waste consisted only of pH neutralization and stabilization. However, other sewer lines existed between the Arkansas Ordnance Plant and the Rocky Branch Creek interceptor, and some plant wastes may have entered the sewer system through these lines before and after the construction of the process waste outfall.

Before arrangements were made to treat pesticide plant waste, commercial fishermen and residents along Bayou Meto frequently complained of odors in the Bayou, odd odors and tastes in fish, and occasional fish kills. After the Old STP began accepting the plant waste for treatment, the complaints continued but were fewer. As a result of the complaints, the Arkansas Pollution Control Commission conducted a special survey in the upper Bayou Meto basin in the first half of 1967. The study linked the problem with high 5-day biochemical oxygen demand (BOD_5) loading and ineffective phenolics removal in the sewage treatment system.

Since 1969, process wastewater from the Vertac Plant site was conveyed via the sewage collection lines to the aeration basin/oxidation ponds complex known as the West WWTP. Currently, the West WWTP receives treated effluent from the onsite leachate collection and treatment system.

Off-Site Remedial Measures

The Arkansas Health Department quarantined Rocky Branch Creek in the late 1970s from where it flows through the Vertac property to its confluence with Bayou Meto, and quarantined Bayou Meto from Jacksonville to its confluence with the Arkansas River. The quarantine includes an advisory discouraging the consumption of fish, shellfish, and waterfowl taken in the affected areas as well as a ban on commercial fishing in the Bayou.

Remedial measures implemented during the late 1980s include excavating of contaminated soil and restricting access to the Rocky Branch Creek Flood Plain. Environmental sampling conducted in 1988 indicated that soil in two residential areas (a drainage area west of the east leg of Rocky Branch Creek at the Vertac property line, and land along the east side of the west leg of Rocky Branch Creek) contained TCDD concentrations in excess of 1.0 ppb. In September 1988, Hercules Inc. signed an

Administrative Order of Consent to remove these soils in developed residential areas. Removal of these soils was completed in February 1989.

In addition, Hercules Inc. purchased a parcel of undeveloped residential property with soil TCDD levels between 1.0 and 5.0 ppb (Figure 2-6, which appears later in this section). By fencing this land and not allowing residential development, Hercules has effectively implemented access-and-use restrictions. Fences with warning signs have been constructed to deter access from the residential area south of the Vertac property to the west leg of Rocky Branch Creek.

SITE CHARACTERISTICS

A detailed description of the Vertac site characteristics is in Sections 3 and 4 of the *Off-site Remedial Investigation, Final Report* (U.S. EPA, December 1985). Topics covered include geography, geology, soils, meteorology, hydrology, groundwater, land use, population, and flood plains.

NATURE AND EXTENT OF OFF-SITE CONTAMINATION

PREVIOUS STUDIES AND REPORTS

A great deal of data have been collected since the Vertac Plant was identified as a potentially hazardous site in 1978. These data have formed the basis for several reports covering onsite and off-site contamination, environmental conditions, groundwater, and geology. The data in these reports will not be repeated here. The major documents are listed in Table 2-1.

PRE-1985 RI DATA

ADPC&E and EPA conducted preliminary environmental sampling for pesticide contamination in the Vertac off-site investigation area before the 1985 RI. This sampling occurred between June 1975 and May 1983. APDC&E compiled the sampling results in their 1983 report. The pre-RI sampling was not conducted under rigorous field and laboratory quality control practices, and accurate records concerning sampling methods and locations are not available for all cases. Consequently, these data are of questionable quality. Subsequent data, described in the following discussions, are much more extensive and were collected, handled, and analyzed under strict data quality procedures. The data from more recent site investigations are assumed to best represent the nature and extent of contamination.

1985 OFF-SITE REMEDIAL INVESTIGATION

The RI for the Vertac off-site area was performed between the fall of 1983 and spring of 1985. The purpose was to determine if TCDD migrated beyond the plant site and, if it had, to identify contaminated areas.

Previous studies suggested that contamination in the investigation area would be concentrated in the sewage collection and treatment system and along the nearby watercourses (Rocky Branch Creek and Bayou Meto). TCDD is known to have an extremely low water solubility and a strong tendency to bind to soils or sediments. Therefore, the RI field work consisted of soil and sediment sampling and analysis, as well as a series of special investigations, including:

- A flood plain delineation study to estimate the amount of soil that may have been contaminated by flooding

Table 2-1
Vertac Information Sources (sheet 1 of 2)

Source	Description
Aerial reconnaissance of Vertac, Inc., Jacksonville, Arkansas; U.S. EPA, Las Vegas, Nevada, November-May 1979.	Historical photographs used to document changes at Vertac site and locations of spills and contamination.
Final Report for Environmental Assessment Study, Vertac Chemical Corp. Site, Jacksonville, Arkansas. Developers International Service Corp. (DISC), Memphis, Tennessee, October 1982.	Developed to satisfy the requirements of 1982 Consent Decree; contains assessment of onsite conditions.
Supplemental Report for Environmental *Assessment Study, Vertac Chemical Corp. Site, Jacksonville, Arkansas.* DISC, December 1982.	DISC response to EPA questions that followed review of previous DISC report. Includes results of recent testing and outlines proposed remedial measures.
Technical Report for Rocky Branch, Bayou Meto, and Lake DuPree. Environmental Toxicological Consultants, March 1983.	Summarizes off-site data collected since 1979 for the three water bodies. (Final report with recent sampling data published in late 1983.)
Summary of Technical Data, Jacksonville, Arkansas. Arkansas Department of Pollution Control and Ecology, no date (mid-1983).	Compiles data collected in conjunction with the Vertac Plant. Includes virtually all sampling data and excerpts of reports listed above.
Proposed Onsite Environmental Remediation-- Remediation Construction Plan Package for Vertac Corporation Plant Site, Jacksonville, Arkansas. D'Appolonia, January 1984.	Provides details on the slurry wall, French drain system, and cap construction.
Offsite Remedial Investigation Final Report. Prepared by CH2M HILL and Ecology and Environment for U.S. EPA Region 6, December 1, 1985.	Presents results of environmental sampling, plus special studies including delineating sonar survey, water use inventory, sewer lamping, and aquatic biota survey. Also, characterizes the off-site area and site history.
Vertac Off-site Endangerment Assessment, Final Report. Prepared by CH2M HILL for U.S. EPA Region 6, June 1986.	Evaluates potential for contaminant migration, exposure pathways and scenarios, and risks associated with off-site contamination.
Vertac Off-site Feasibility Study, Final Report. Prepared by CH2M HILL for U.S. EPA Region 6, June 1986.	Based on the 1985 RI. Includes an evaluation of alternatives for remediating potential hazards posed by off-site contamination. Identifies seven potential remedial alternatives.
Remediation of Dioxin-Contaminated Sediments Near the Vertac NPL Site. Assistant Administrator, Office of Solid Waste and Emergency Response, U.S. EPA, February 1, 1989.	Memorandum giving EPA's rationale in determining appropriate remedial actions for sediments in and along the west leg of Rocky Branch and Bayou Meto downstream from the Vertac Plant site.
Report on Fine Grid Sampling Plan (For TCDD and 2,3,7,8-TCDD). Prepared by IT Corporation for Hercules Inc., October 1988.	Summarizes off-site sampling results from 1988 sampling effort sponsored by Hercules Inc.
Vertac Chemical Plant Draft Report. Prepared by Jacobs Engineering Group Inc. for U.S. EPA Region 6, September 28, 1988.	Includes results of analysis of duplicate samples taken by IT Corporation.

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Table 2-1
Vertac Information Sources (sheet 2 of 2)

Source	Description
TES IV Work Assignment #649-Vertac Soil Sampling. Prepared by Jacobs Engineering Group for U.S. EPA Region VI, June 1, 1989	Includes results of fine-grid and dust sampling.
Hercules/Vertac Off-site Study Final Report, May 1990	Includes results of 1987 Hercules-sponsored sampling.

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CVOR195/112.51

- A sewer lamping study to estimate the amount of sediment in the sewage collection system

- A sonar survey to estimate the amount of sediment in the impoundments, including aeration basin and oxidation ponds

- An aquatic biota survey

The soil and sediment sampling results are tabulated in Volume II of the 1985 off-site RI report (EPA, December 1985). A total of 324 soil and sediment grab samples were collected during the RI and tested for TCDD. Of the 324 samples:.

- 74 samples were taken in December 1983; 40 samples contained measurable quantities of TCDD

- 21 samples were taken in June 1984; one contained a measurable quantity of TCDD

- 225 samples were taken in August 1984; 79 contained measurable quantities of TCDD

TCDD method detection limits for these analyses generally were within the range of 0.01 to 1.0 ppb.

Groundwater sampling and analysis were not included in the study plan. EPA's decision to exclude groundwater sampling was based on the low water solubility of TCDD and on the results of a limited testing of deep wells in the early stages of the RI, which showed no measurable TCDD in groundwater.

Air was considered a potential pathway of contaminant migration. Air monitoring off-site was not pursued because the area is heavily vegetated, minimizing airborne transport of soil and sediment.

Previous studies indicated the presence of contaminants other than TCDD in the investigation area, such as 2,4-D, 2,4,5-T, 2,4,5-TP, chlorinated benzenes, and chlorinated phenols. The RI concentrated on TCDD because it was determined to be the most hazardous contaminant in the area, and remediation for TCDD would likely remediate other contamination problems. Limited exploratory testing was performed for the other compounds. Elevated levels of chlorobenzenes, chlorophenols, and other contaminants were found principally in the sewage system, to a much lesser degree at surface locations near the Vertac Plant, and sporadically at locations distant from the plant in Rocky Branch Creek. Findings on these other contaminants appear consistent with the known tendency of these contaminants to degrade more readily than TCDD. In the areas where contaminants other than TCDD were found, TCDD was found at concentrations of greater concern than concentrations of the other contaminants. This supported the assumption that remediation for TCDD will also remediate other compounds.

POST-1985 RI DATA

Several sampling efforts have been conducted in the Vertac off-site area since 1985. A brief description of these sampling events is given below.

1. **1987 Hercules Grab Sampling.** Samples were collected from many of the locations sampled in the 1985 RI studies. This investigation included:

    - TCDD analysis of fish tissue from Lake DuPree

- TCDD and partial priority pollutant analysis of sediment samples from the West WWTP aeration basin and oxidation ponds, and TCDD analysis from areas in and around the Old STP and West WWTP

- TCDD analysis of soils and sediments from Rocky Branch Creek, Bayou Meto, and Lake DuPree, and land adjacent to Rocky Branch Creek and Bayou Meto

2. **1988 Hercules Fine-Grid Sampling.** Soil and sediment samples were collected for TCDD analysis from the Rocky Branch Creek banks, the residentially-zoned flood plain immediately west of the east leg and immediately east of the west leg of Rocky Branch Creek, and the West WWTP facilities. Fish samples from Lake Dupree were also analyzed for TCDD. The results of this sampling effort are compiled in the *Report on Fine Grid Sampling Plan (For TCDD and 2,3,7,8-TCDD), Volume I* (Hercules Inc., October 1988).

3. **1988 EPA Fine-Grid Sampling.** Soil samples were collected from the undeveloped residentially-zoned flood plain immediately west of the west leg of Rocky Branch Creek and south of the Vertac property. The samples were analyzed for TCDD.

4. **1989 EPA Fine-Grid Sampling.** The extent of contamination was delineated by sampling areas surrounding the soil grids found to contain TCDD levels greater than 5.0 ppb in the 1988 EPA sampling effort.

5. **Ongoing USFWS Wood Duck Studies.** The effect of contamination on wood duck reproduction is currently being studied.

DATA SUMMARY FOR RECENT SITE INVESTIGATIONS

Figure 2-5 is a base map showing all areas sampled during the investigations referenced above. These areas are enlarged in Figures 2-6 through 2-12, which summarize the most recent TCDD sampling data available for the Vertac off-site investigation area. Data on TCDD concentrations in the off-site areas are available from several investigations. These investigations and the resultant data vary with respect to time, sampling protocols, and quality assurance/quality control (QA/QC) procedures. For the development of this FS, the most recent sampling data were used. Further, in areas where both grab-samples and fine-grid samples are available, data from the fine-grid sampling are used. This approach is based on the following:

- Environmental concentrations may change over time due to a variety of mechanisms, and the most recent data should be closest to current contaminant levels

- The fine-grid sampling protocol used in 1988 and 1989 generally gives results that are more representative of actual environmental concentrations than does grab sampling, which was used in previous sampling efforts

- The recent sampling efforts were subjected to more rigorous QA/QC than were earlier studies.

Figure 2-6 also delineates the areas fenced and excavated in recent remediation activities. Most of the data shown were obtained in 1988 or 1989. However, for the following locations, the figures show data from 1984 or 1987 sampling studies because these locations were not sampled in 1988-1989:

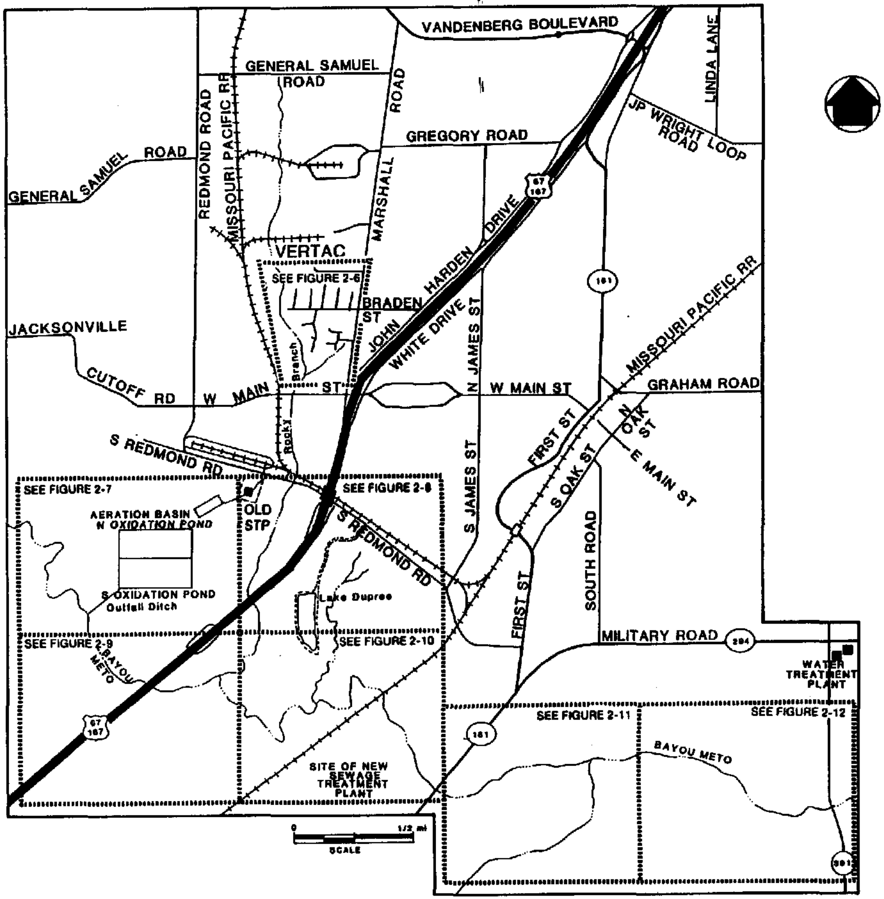

FIGURE 2-5

AREAS SAMPLED IN RECENT INVESTIGATIONS

Vertac Off-Site FS
Jacksonville, Arkansas

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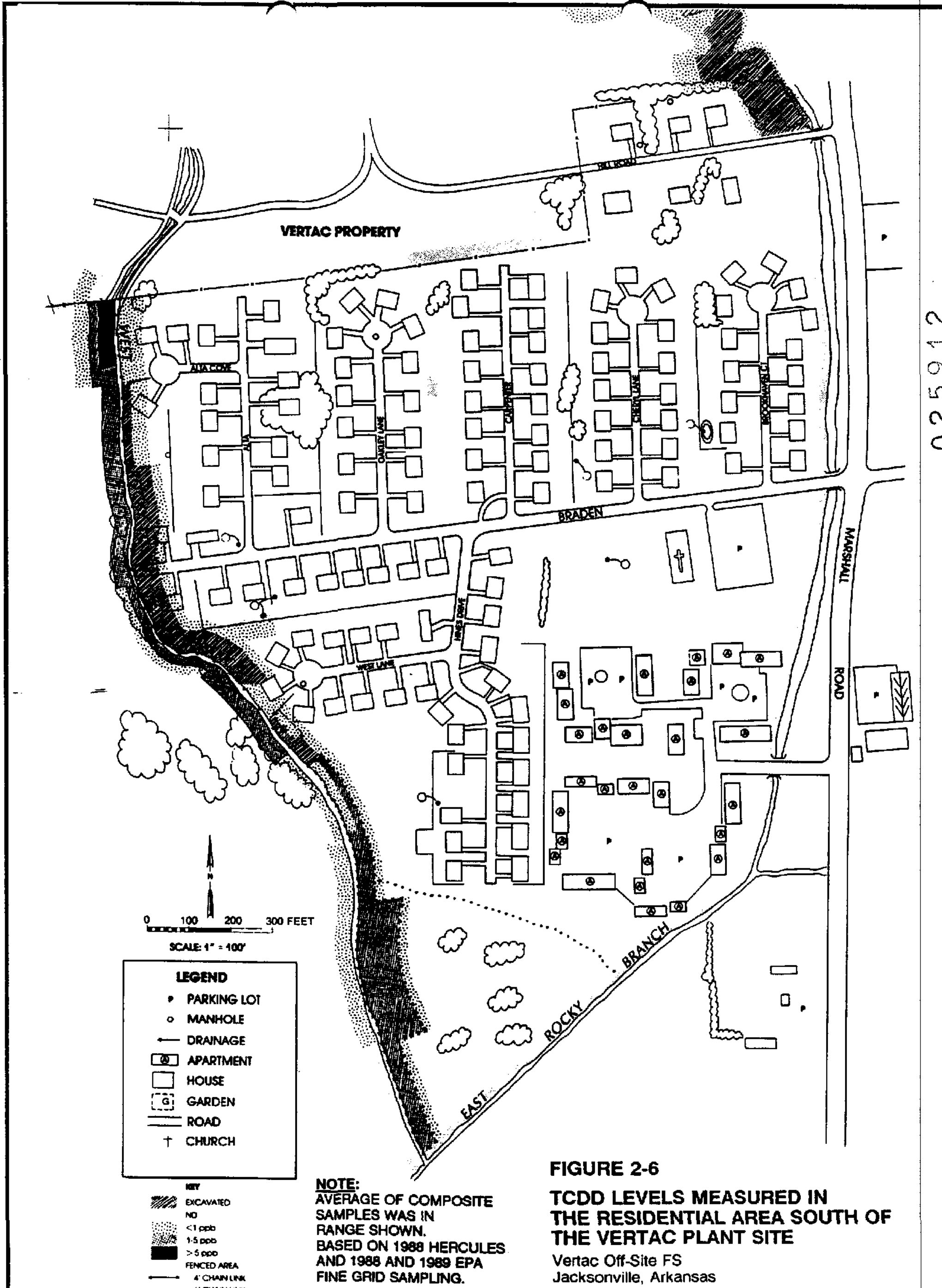


NOTE:
AVERAGE OF COMPOSITE SAMPLES WAS IN RANGE SHOWN.
BASED ON 1988 HERCULES AND 1988 AND 1989 EPA FINE GRID SAMPLING.

FIGURE 2-6

TCDD LEVELS MEASURED IN THE RESIDENTIAL AREA SOUTH OF THE VERTAC PLANT SITE

Vertac Off-Site FS
Jacksonville, Arkansas

025912

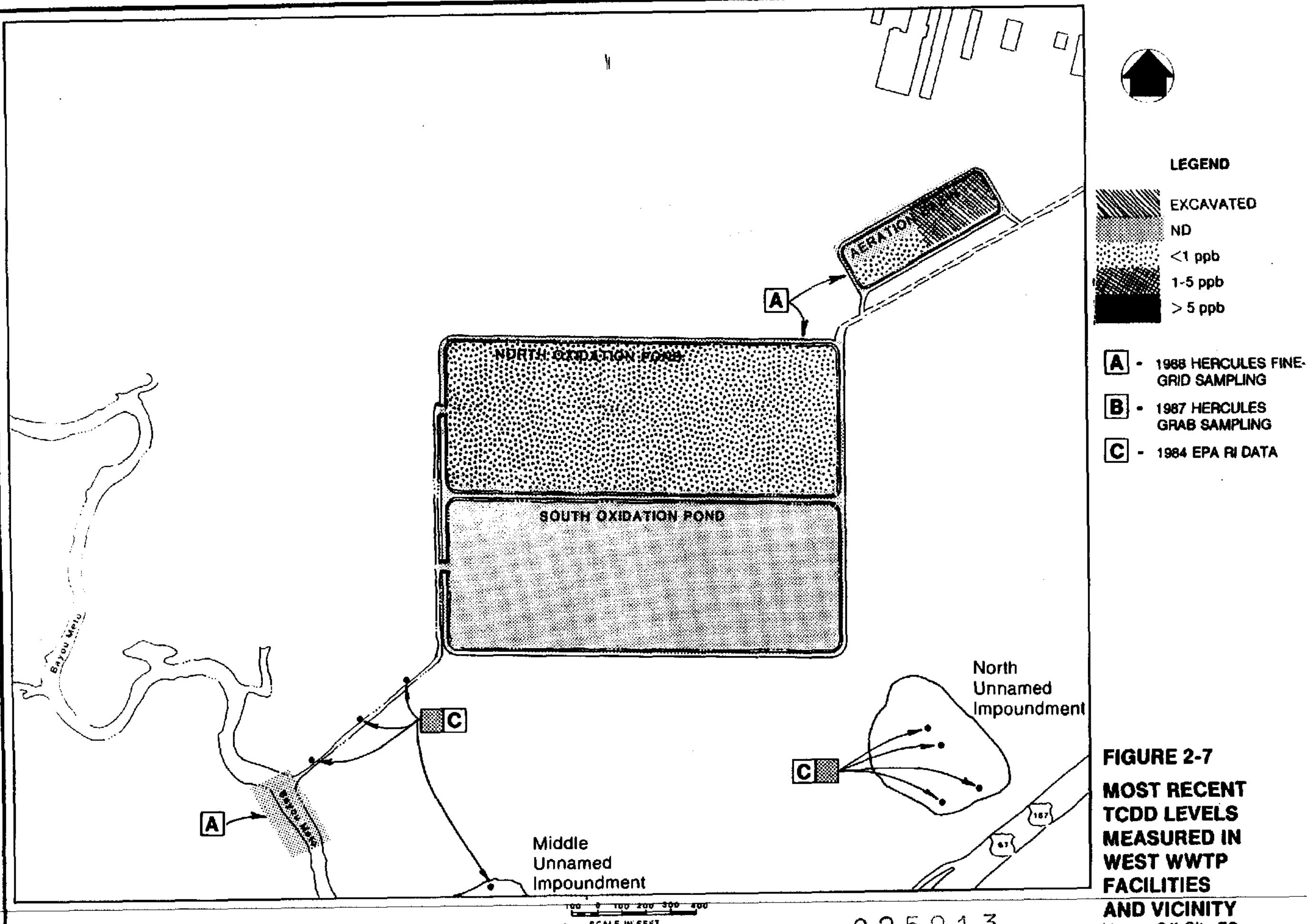


FIGURE 2-7

MOST RECENT TCDD LEVELS MEASURED IN WEST WWTP FACILITIES AND VICINITY

Vertac Off-Site FS
Jacksonville, Arkansas

025913

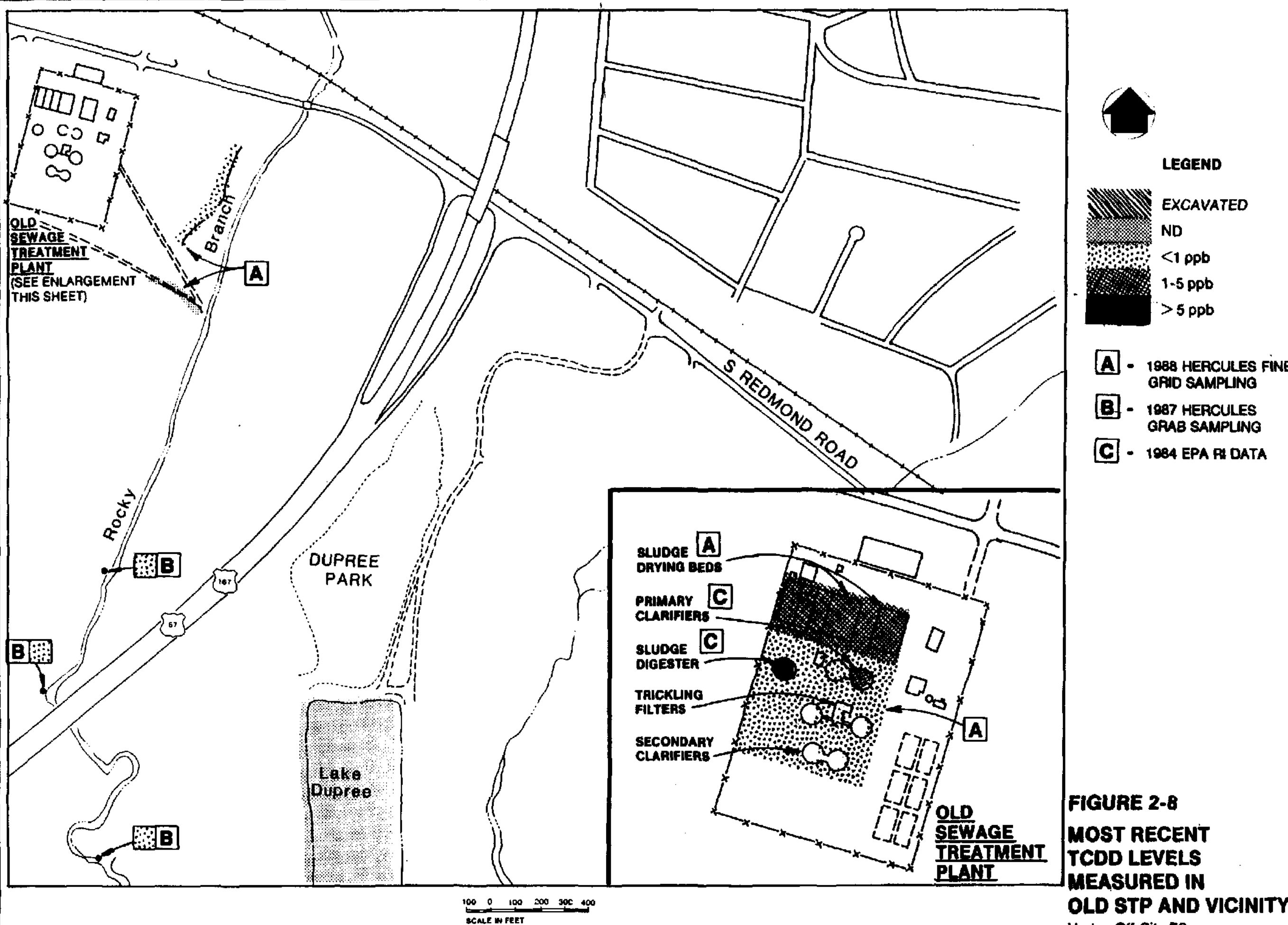


FIGURE 2-8
MOST RECENT TCDD LEVELS MEASURED IN OLD STP AND VICINITY

Vertac Off-Site FS
Jacksonville, Arkansas

025914

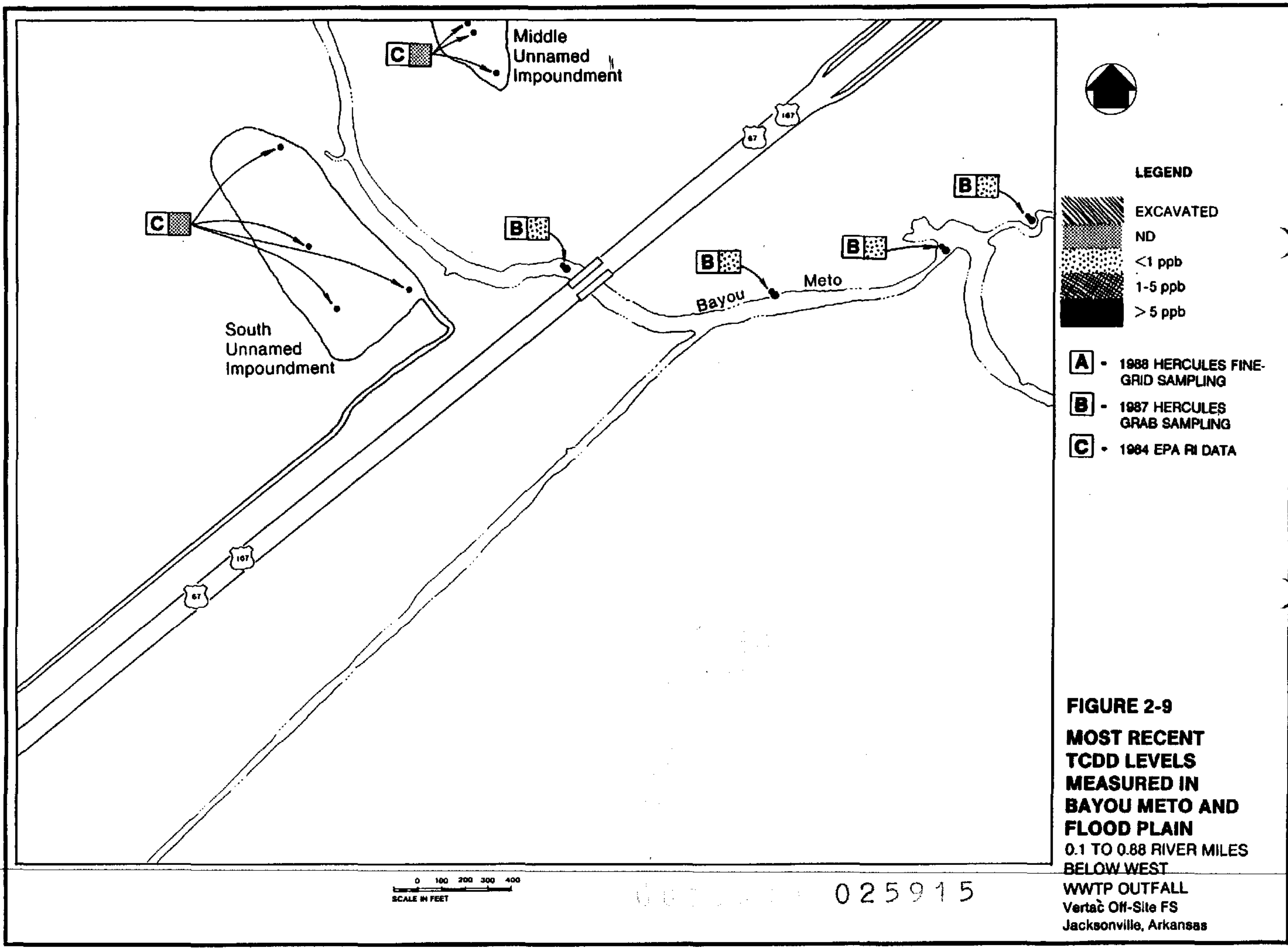


FIGURE 2-9

MOST RECENT TCDD LEVELS MEASURED IN BAYOU METO AND FLOOD PLAIN

0.1 TO 0.88 RIVER MILES BELOW WEST WWTP OUTFALL

Vertac Off-Site FS
Jacksonville, Arkansas

025915

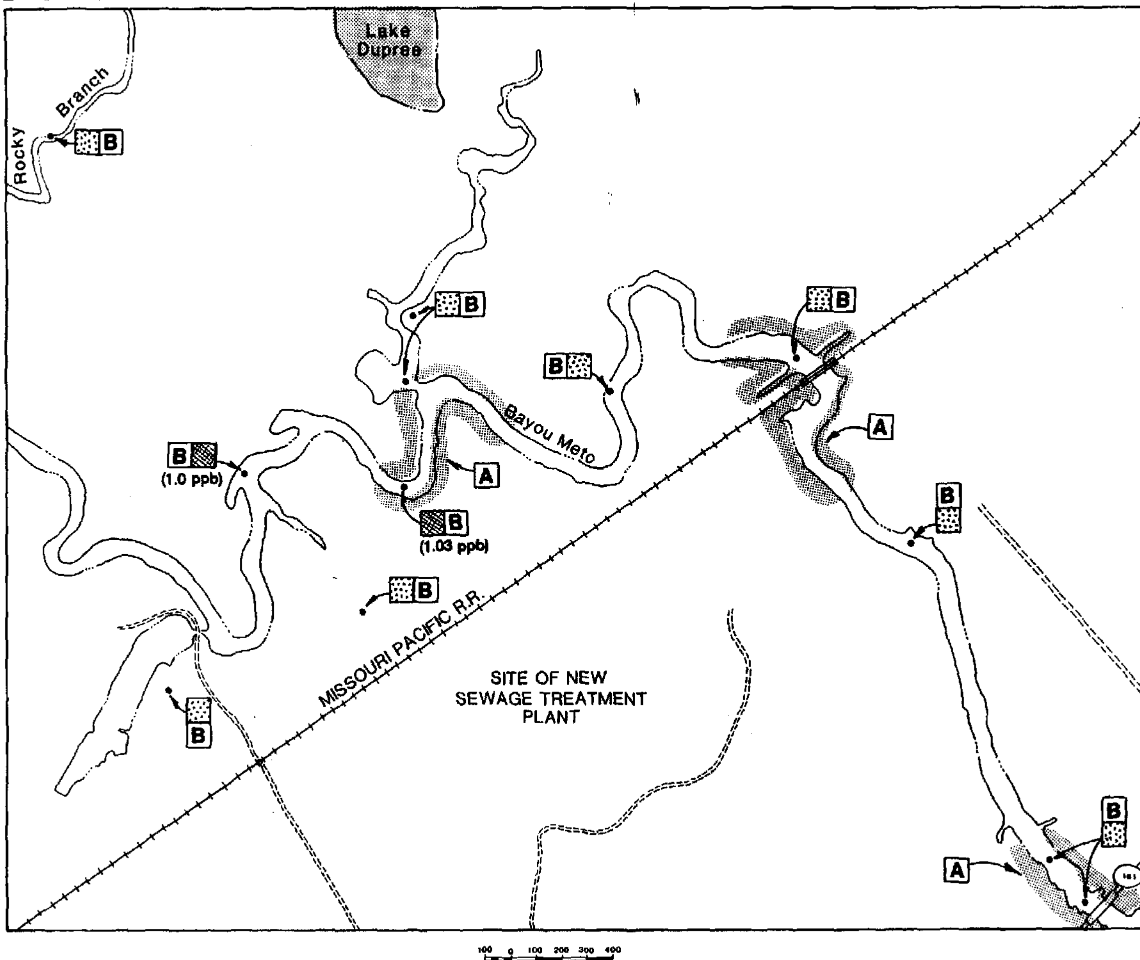


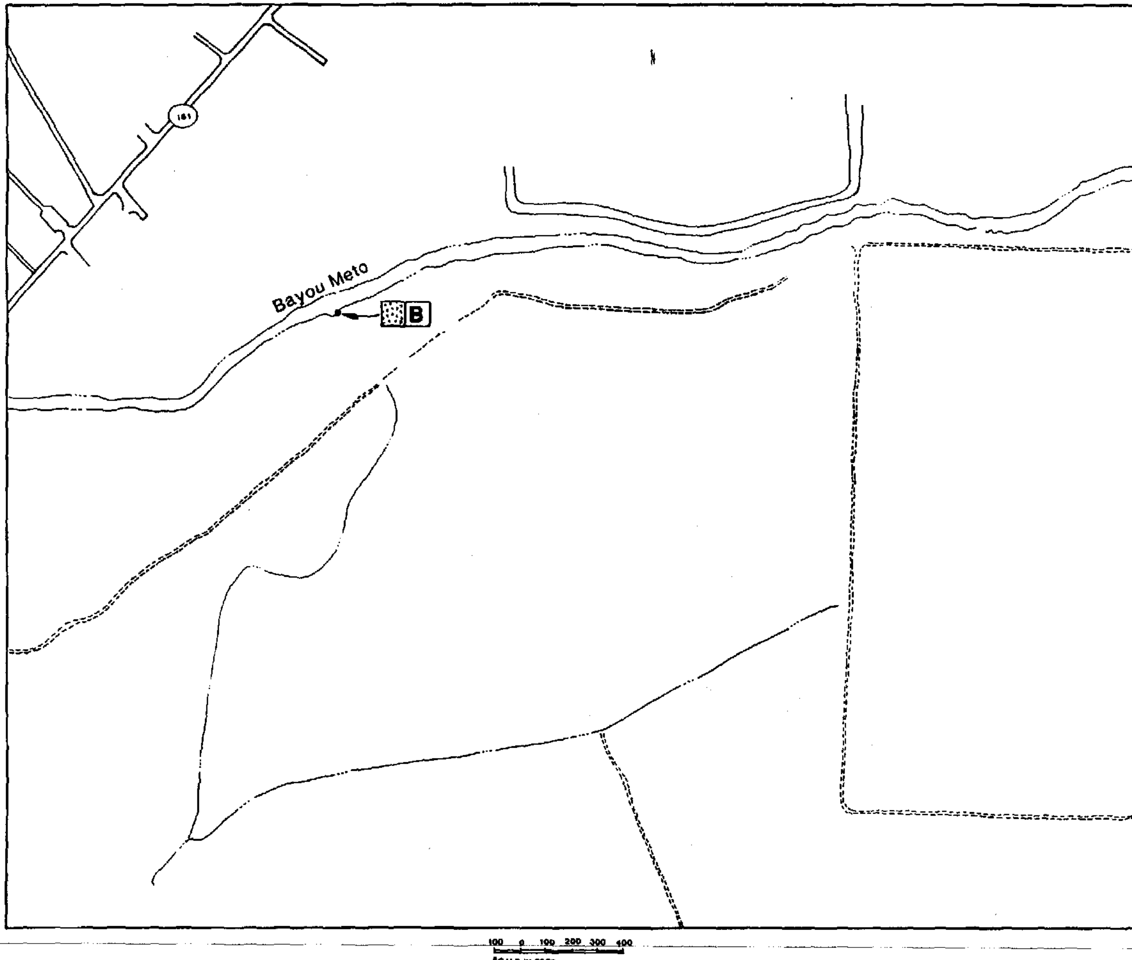
FIGURE 2-10

MOST RECENT TCDD LEVELS MEASURED IN BAYOU METO AND FLOOD PLAIN

0.88 TO 2.40 RIVER MILES BELOW WWTP OUTFALL

Vertac Off-Site FS
Jacksonville, Arkansas

025916



LEGEND

EXCAVATED

ND

<1 ppb

1-5 ppb

> 5 ppb

A - 1988 HERCULES FINE-GRID SAMPLING

B - 1987 HERCULES GRAB SAMPLING

C - 1984 EPA RI DATA

FIGURE 2-11

MOST RECENT TCDD LEVELS MEASURED IN BAYOU METO AND FLOOD PLAIN

2.40 TO 3.23 RIVER MILES BELOW WEST WWTP OUTFALL

Vertac Off-Site FS
Jacksonville, Arkansas

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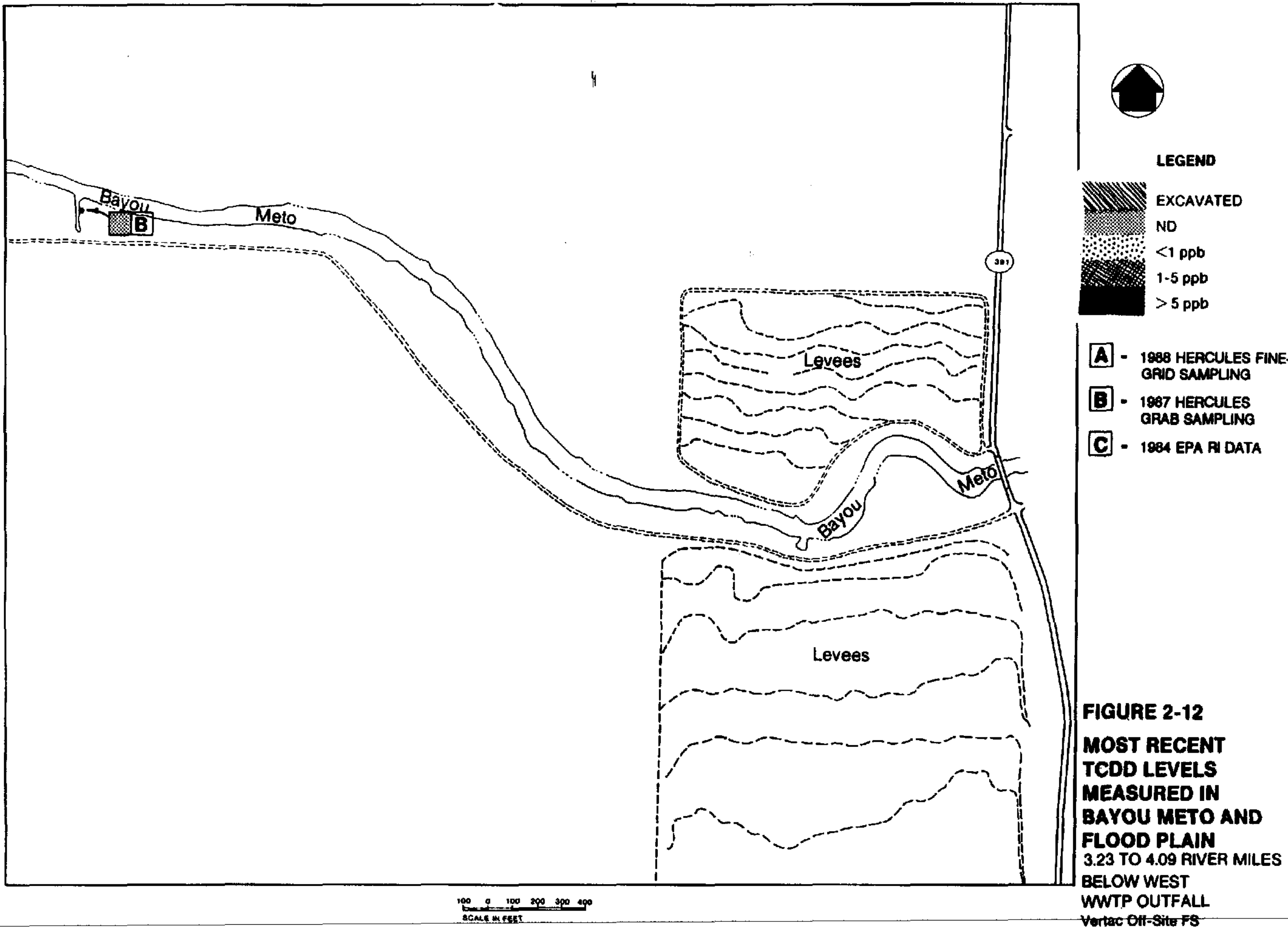

FIGURE 2-12

MOST RECENT TCDD LEVELS MEASURED IN BAYOU METO AND FLOOD PLAIN
3.23 TO 4.09 RIVER MILES BELOW WEST WWTP OUTFALL

Vertac Off-Site FS
Jacksonville, Arkansas

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- The unnamed impoundments (Figures 2-7 and 2-9) were sampled during RI in 1984.

- Some locations in Bayou Meto, Rocky Branch Creek, and surrounding flood plains (Figures 2-8, 2-9, 2-10, 2-11, and 2-12), which were sampled by EPA in 1984 and Hercules in 1987

- The oxidation pond's outfall ditch (Figure 2-7), which was sampled by EPA in 1984

- The sewage collection lines (Figure 2-13), which were sampled by EPA in 1984

The land south of the Vertac Plant site is zoned for residential use (Figure 2-14). Soil containing TCDD concentrations above the 1.0 ppb action level has already been excavated from areas with residential development (these areas were shown in Figure 2-6). These soils were placed in bags and temporarily stored on the Vertac Plant site. However, there is still soil with TCDD levels greater than 1.0 ppb in undeveloped portions of this residentially zoned area. A strip of land along the west flood plain of the west leg of Rocky Branch Creek contains TCDD concentrations between 1.0 and 5.0 ppb (Figure 2-6). This area includes 1988 EPA sampling Grid Numbers 10, 11, 13, 14, 15, and 16 from EPA's 1988 sampling effort. In addition, the sections immediately south of the Vertac property in the same flood plain area (1988 EPA Grid Numbers 17 and 18) contained greater than 5.0 ppb (maximum of 9.65 ppb) TCDD (Figure 2-6).

The land east of the west leg of Rocky Branch Creek north of the confluence with the east leg also contains TCDD levels between 1.0 and 5.0 ppb (Figure 2-6). The wide section in the middle of this parcel of land encompasses the location of former creek meanders. Hercules Inc. purchased this property and fenced the area to restrict access.

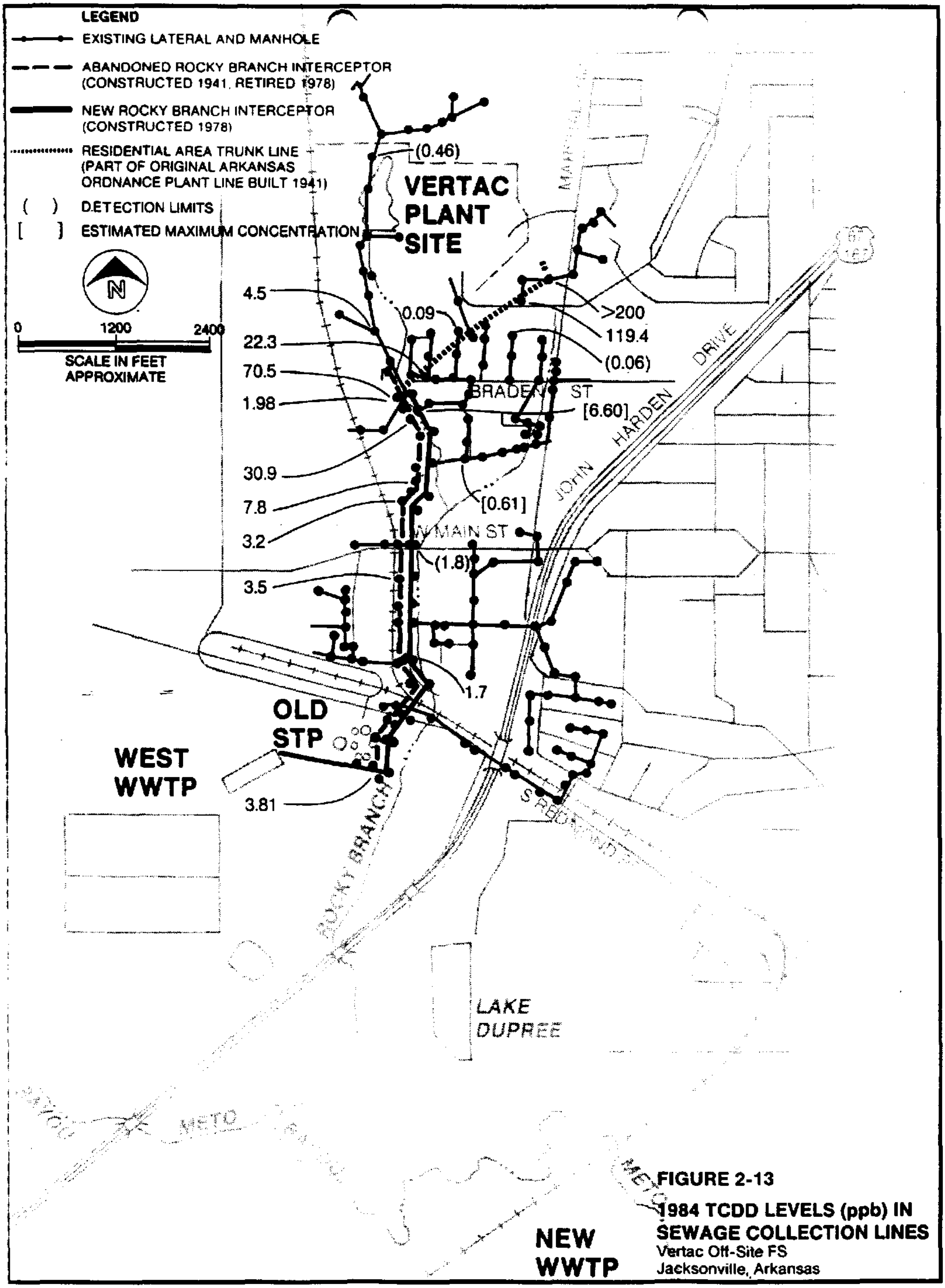

FIGURE 2-13

1984 TCDD LEVELS (ppb) IN SEWAGE COLLECTION LINES

Vertac Off-Site FS

Jacksonville, Arkansas

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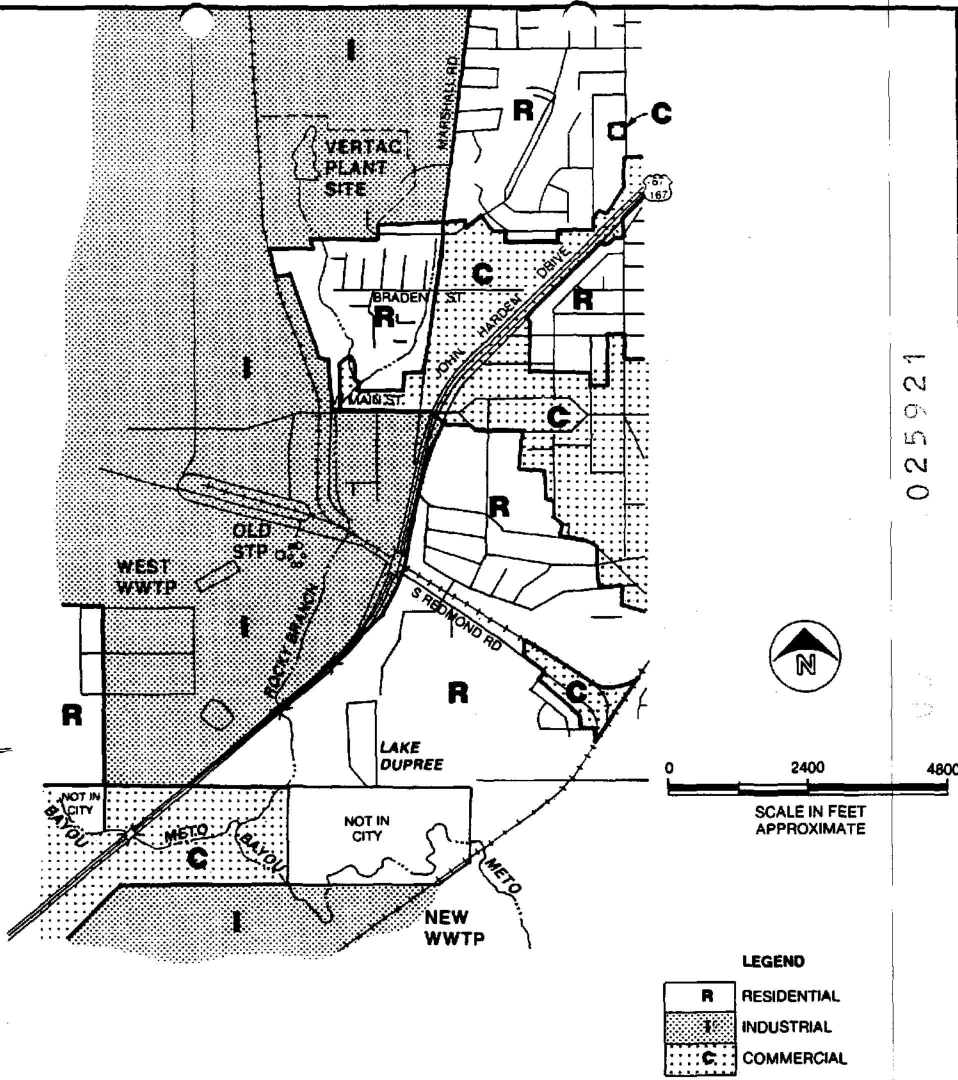

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FIGURE 2-14

ZONING MAP
Vertac Off-Site FS
Jacksonville, Arkansas

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Other than the areas mentioned above, sampling has shown that the remaining soil within the Rocky Branch Creek flood plain residential area contains TCDD concentrations lower than the 1.0 ppb action level.

Sampling of the West WWTP facilities indicated that only the eastern half of the aeration basin sediments contained TCDD levels greater than 1.0 ppb in 1988 (Figure 2-7). Composite sample concentrations were 2.83 ppb in the southeast quadrant and 1.41 ppb in the northeast quadrant of the aeration basin. The most recent sampling of the western half of the aeration basin, the north and south oxidation ponds, the outfall ditch, and the outfall delta sediments in Bayou Meto found TCDD levels that were less than 1.0 ppb or nondetectable (Figure 2-7).

The grounds of the Old STP were sampled in 1988 (Figure 2-8). A composite sample of the sludge-drying beds contained 2.79 ppb TCDD. A composite sample of the soil surrounding the sludge beds contained 1.01 ppb TCDD. (These two sampling grids are included together as the 120-by-267-foot Area E-1 in the 1988 Hercules Inc. report prepared by IT Corp.). The soil surrounding the other facilities of the Old STP (Section E-2; Hercules Inc., October 1988) contained less than 1.0 ppb of TCDD. The contents of the treatment units have not been sampled since 1984. At that time, the sludge in the digester contained a maximum of 12.46 ppb TCDD, the east primary clarifier contained 1.62 ppb TCDD, and the west primary clarifier contained 0.23 ppb TCDD. The trickling filters and the secondary clarifiers were not sampled.

Figures 2-8 through 2-12 show that the most recent samples of the Bayou Meto flood plain and the Rocky Branch Creek flood plain downstream from the Old STP contained TCDD concentrations lower than 1.0 ppb.

As mentioned previously, the sewer collection line sediments were sampled only in 1984. The 1984 data are shown in Figure 2-13. At that time, the sediments in the active sewer line contained a maximum concentration in excess of 200 ppb TCDD. The abandoned Rocky Branch Creek interceptor contained a maximum sediment concentration of 70.5 ppb TCDD.

Rocky Branch Creek and Bayou Meto sediments have been sampled in 1984, 1987, and 1988. Figure 2-10 shows that two sediment samples from Bayou Meto contained TCDD concentrations between 1.0 and 5.0 ppb. It should be noted that the actual concentrations in these samples were 1.0 and 1.03 ppb.

DATA COMPARISON

Sampling Techniques and Locations

The 1985 RI report presented TCDD data for grab samples collected from the soils, sediments, and sludges from the wastewater collection and treatment system, flood plains, Rocky Branch Creek, and Bayou Meto. Most samples were collected in 1984. In 1987, Hercules Inc. sponsored a sampling effort designed to be comparable to the 1985 RI data. The 1987 effort consisted of grab samples collected from approximately the same locations and depths as in 1984. Soils/sediments were sampled at 3-inch intervals down to 30 inches.

Sampling techniques changed considerably in 1988. Hercules sponsored another sampling effort, and IT Corporation (Hercules' contractor) sampled soils and sediments using grid sampling. In the grid sampling, aliquots of soil or sediment were collected from locations spaced 10 feet apart within a defined area (grid) not larger than 5,000 square feet. The individual aliquots were then composited for analysis. Soil and sediment samples were taken from 0 to 3 inches deep. Creek banks were sampled at distances of 6, 36, and 60 inches from the water line. Stream sediment was collected midstream in nearly dry creek beds. Sludge samples were collected at the sediment/

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water interface and at the interface between sediment and the clay bottom of the aeration basin and oxidation ponds.

In November 1988 EPA conducted fine-grid sampling of soil along the west side of the west leg of Rocky Branch Creek south of the Vertac property. Additional grid sampling was performed near the Vertac property line in January 1989.

Comparability of Data

The 1984 and 1987 TCDD sampling data are directly comparable, and comparison of these two data sets may identify trends, if any. The 1988 grid-sampling data are not directly comparable to the earlier findings; however, general comparisons can be made in some cases. Individual grab samples may either overestimate or underestimate contaminant concentrations contained in a given area. Grid sampling gives a better estimate of representative concentrations, but does not identify "hot spots" (concentrated areas of contamination). Some of the grid-sampling data cannot be compared to earlier data because those locations were not previously investigated.

Historical Trends

The TCDD concentrations found in soil/sediment in the various sampling efforts between 1984 and 1988 are compared in Table 2-2. Once the source of contamination is removed or reduced, TCDD levels in the environment would be expected to decrease due to the combined actions of dispersion by wind and water, downstream transport of contaminated soil/sediment, dilution by mixing and covering with clean material, biotransformation, and physical/chemical transformation.

TCDD levels tended to decrease between 1984 and 1987. A total of 59 samples are directly comparable between the 1984 and 1987 sampling events (that is, sample aliquots were collected at the same location and depth and analyzed individually). These 59 samples compare as follows:

- In 1987, 47 samples (80 percent) were lower than in 1984, with 31 samples (53 percent) at least 50 percent lower. The largest decrease was from 37.9 ppb in 1984 to 2.9 ppb in 1987 in the aeration basin.

- In 1987, 11 samples (19 percent) were higher than in 1984, and 5 samples (8.5 percent) were more than 50 percent higher. The greatest increase was from 0.92 ppb in 1984 to 1.3 ppb in 1987 in the oxidation pond.

- In 1987, 1 sample (2 percent) was exactly the same as in 1984.

It should be noted that this is not a statistical treatment of the data (e.g., lower than does not imply a statistically significant difference), but simply a mathematical comparison. TCDD levels at nearly half of the 1987 sampling stations were within plus or minus 50 percent of their 1984 concentration.

Table 2-2 shows 1984, 1987, and 1988 samples from comparable areas of particular interest within the Vertac off-site investigation area. In these areas, TCDD concentrations were consistently lower in 1987 and 1988 than they were in 1984.

The elevated levels detected in aeration basin samples of 1984 (37.9 and 16.2 ppb) and 1987 (7.6 ppb) were not found in later samples. This decrease may stem from the sampling methods used (e.g., grab sampling of a hot spot versus dilution via composite sampling) or may reflect biodegradation or another attenuation process. In any case, the 1988 fine-grid sampling found TCDD levels of less than 5.0 ppb in the aeration basin and less than 1.0 ppb in the oxidation ponds.

TABLE 2-2
SAMPLING DATA COMPARISON TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1984 DATA	1987 DATA	1988 DATA*
BACKGROUND	VANBERG BLVD	ABCD		ND-0.023	
OXIDATION POND	NW QUAD	A	3	1.2	
		D	0.7	0.4	
		S			0.29 [4]
		IN			NA (ND-0.3) [4]
	NE QUAD	A	3.6	1.5	
		A	1.8	1.8	
		D	0.98	ND-0.01	
		F	0.51	0.025	
		S			0.97 [4]
		IN			NA(ND-0.3)DU [4]
	SW QUAD	A	1.98	0.41	
		D	0.34	0.0061	
		S			NA (ND-0.3) [4]
		IN			NA (ND-0.3) [4]
	SE QUAD	A	0.92	1.3	
		A	0.2	0.022SP	
		A	1.3	1.1	
		C	0.57	0.0059	
		G	0.44	ND-0.029	
		J	0.15	0.015	
		S			NA (ND-0.3) [4]
		IN			NA (ND-0.3) [4]

A = 0-3 inch
B = 3-6 inch
C = 6-9 inch
D = 9-12 inch
E = 12-15 inch

F = 15-18 inch
G = 18-21 inch
H = 21-24 inch
I = 24-27 inch
J = 27-30 inch

S = surface sample
IN = interface smpl b/w bottom sedmnt & liner
X = deep bottom samples

NA = not analyzed for 2,3,7,8-TCDD when TCDD < 1
( ) = non-isomer-specifc TCDD concentration
ND = non-detectable at given detection concentration
DU = duplicate associated with sample; highest value shown
SP = split sample; highest value shown
* Highest value of sampling grid used
** samples taken at 6,36, and 60 inches
[ ] = number of grabs (surface samples) or cores (interface samples)
taken in the sampling grid

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TABLE 2-2
SAMPLING DATA COMPARISON TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1984 DATA	1987 DATA	1988 DATA*
OXIDATION POND					
OUTFALL	DELTA	A	0.74	0.45	
		S			NA(ND-0.3)DU [10]
	N BANK	A	2	1.2SP	
		**			NA(ND-0.3)DU [26]
	N BANK LEFT	A	3.5	0.5SP	
		B	1.1	0.6SP	
		C	2.1	0.68	
		**			NA(ND-0.3)DU [26]
AERATION BASIN	NW QUAD	S			NA (ND-0.3) [6]
		IN			NA (ND-0.3) [6]
	NE QUAD	A	37.9	2.9	
		E		1.5DU	
		F		1.7	
		S			1.41 [6]
		IN			NA (ND-0.3) [6]
	SW QUAD	A	6.5	2.7	
		E		0.8DU/SP	
		S			NA (0.71) [6]
		IN			NA (ND-0.3) [6]
	SE QUAD	A	16.2	7.6	
		G	2.08	1.9SP	
		S			2.83 DU [6]
		IN			NA(ND-0.3)DU [6]
BAYOU METO					
.1-.88 mi below outfall	MIDSTREAM	A	0.27	0.024SP	
	N BANK	A	0.47	0.036SP	
	CONFLUENCE	A	0.53	0.29	
		D		ND-0.0065	
	N BANK	A	0.74	0.8SP	
.88-2.4 mi below outfall	S DUPREE PRK	A	0.22	0.36DU	
	SOYBEAN FLD.	A	0.06	0.068DU	
	DRY CREEK	A	0.9	0.46SP	
	MIDSTREAM (1mi)	A	0.37	1	
		A	0.1	1.03	
	N BANK (1mi)	**			NA (ND-0.3) [50]

TABLE 2-2
SAMPLING DATA COMPARISON TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1984 DATA	1987 DATA	1988 DATA*
	S BANK (1mi)	A	0.81	0.34	
		B	1.2	0.12SP	
		C	1.1	0.33	
		**			NA (ND-0.3) [38]
	BAY MOUTH	A	0.86	0.41SP	
	WOODLAND	A		0.098	
		C	1.58	0.0046SP	
	N BANK	A		0.49	
		A	1.1	0.53	
		A	0.54	0.85SP	
		B	1.52	0.75SP	
		B	0.78	0.64	
		C		1.7SP	
	MIDSTREAM	A	0.39	0.22	
	RR TRACK	A	0.34	0.25	
	N BANK (2mi)	**			NA (ND-0.3) [50]
	S BANK (2mi)	**			NA (ND-0.3) [50]
	MIDSTREAM(2.25mi)	A	0.25	0.18	
		A	0.31	0.18	
		D		0.0029	
	N BANK (2.4mi)	**			NA (ND-0.3) [50]
	S BANK (2.4mi)	**			NA (ND-0.3) [42]
	HWY 161	A	0.79	0.14SP	
2.4-3.23 mi below outfall	S BANK	A		0.22DU	
		C	1.08	0.54DU/SP	
3.23-4.09 mi below outfall	IRRIGATION	A	0.09	ND-0.0055DU/SP	
ROCKY BRANCH FLOODPLAIN					
WEST LANE	RUNOFF DITCH	A	0.84	0.12	
		C	0.01	0.011SP	
HINES ST.	WOODED PENN.	A		6.8	
	(end of st.)	C	7.58	1.3SP	
W.LEG(0-250ft. frm junct.of W and E legs)	0-20ft.frm crk	S			2.88 [150]
	20-40ft.frm crk	S			1.98 [150]
	40-60ft.frm crk	S			NA (0.869) [150]

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TABLE 2-2
SAMPLING DATA COMPARISON TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1984 DATA	1987 DATA	1988 DATA*
W.LEG(250-500ft. frm junct.of W and E legs)	0-20ft.frm crk	S			2.73 [150]
	20-40ft.frm crk	S			2.02 [150]
	40-60ft.frm crk	S			1.74 [150]
	60-80ft.frm crk	S			1.45 [150]
	80-100ft.frm crk	S			1.34 [150]
	100-120ft. frm crk	S			NA (0.96) [150
E.LEG(0-250ft. frm junct.of W and E legs)	0-20ft.frm crk	S			NA (ND-0.3) [150]
E.LEG(250-500ft. frm junct.of W and E legs)	0-20ft.frm crk	S			NA (ND-0.3) [150]
E.LEG(500-750ft. frm junct.of W and E legs)	0-20ft.frm crk	S			NA(ND-0.3) [150]
ROCKY BRANCH IN THE VICINITY OF STP					
	DRY CREEK	A	1.7	0.97SP	
	W BANK	A	0.05	0.0049	
		S			NA (0.569)DU [50]
	MIDSTREAM	A	0.17	0.098SP	
	DRY CREEK	A		0.64	
		S			NA (ND-0.3) [25]
		C	1.5	0.85SP	
	W BANK DELTA	A	0.11	0.63	
	BEND MIDDLE	A	0.15	0.46SP	
	MIDSTREAM	A	0.16	0.86	
		A	0.41	0.52	
OLD STP AREA					
	PERIMETER	S			1.01 [66]
	SLUDGE DRY BED	S			2.79DU [73]
		A	ND-0.01		

TABLE 2-2
SAMPLING DATA COMPARISON TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1984 DATA	1987 DATA	1988 DATA*
		A	0.77		
		B	6.59		
		B	0.58		
	CLARIFIERS	A	1.62		
		A	0.23		
	CLARIFIER AREA	S			NA (0.307) [39]
	SLUDGE DIGESTER	B	5.3		
		B	12.46		
	SLUDGE COLLCT.ARE	A	ND-0.76		
		A	ND-0.05		
		E	ND-0.21		
		E	0.42		
		X	ND-0.48		
		X	1.19		

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While Table 2-2 presents only the data that can be compared, Appendix E includes summary tables for each of the off-site areas.

QUANTITY OF MATERIAL REQUIRING REMEDIATION

The volume of contaminated material considered for remediation has been estimated based on the available sampling data and chemical- and site-specific action levels. Volumes were estimated in the 1985 RI, the 1986 FS, and the present FS. The amount and location of contaminated material requiring remediation in the Vertac off-site area has changed over time due to decreases in contaminant concentrations, implementation of remedial activities, and refinement and expansion of environmental sampling.

Table 2-3 compares the volumes of material addressed in the 1985 RI and considered for remediation in the 1986 FS. Table 2-4 lists the quantities of contaminated material assumed to require remediation in the present FS. These quantities are based on the action levels developed for the off-site area by ATSDR and the EPA dioxin group (discussed in Section 3), and on the most recent sampling data.

The present FS considers the 1987, 1988, and 1989 sampling data, which were collected after the 1986 FS was conducted. These sampling efforts have better defined the areas requiring remediation under the site-specific TCDD action levels.

Generally, the volumes of contaminated material considered for remediation in the 1986 and the present FS are similar. However, there is one major difference. In the 1986 FS, the volume of material to be remediated included extensive sections of Rocky Branch Creek and Bayou Meto and their flood plains. The present FS assumes that flood plains will be remediated only in areas where TCDD concentrations in soil exceed the pertinent site-specific action level. This includes the Rocky Branch Creek flood plain in the residential area south of the Vertac Plant site, but not the other flood plain

Table 2-3
1985 Remedial Investigation and 1986 Feasibility Study Estimates of TCDD-Contaminated Material Considered For Remediation

Area	Volume[a] Estimated in 1985 RI[b]	Volume Assumed in 1986 FS[c]	Comments on Volume[a] Assumed in 1986 FS[c]
Sewage Collection Lines	47 cy	46 cy	Included allowance for vegetation in sewers.
Old STP	500 cy	1,500 cy of sediment and water in basins 914 cy of soil/sediments in sludge drying beds and outfall ditch	Quantities based on facility dimensions and description of materials in basins.
West WWTP	214,000 cy of sediment	216,000 cy of sludge at 5% solids	Assumed RI-reported sediment was 5% solids.
	180,000 cy of wastewater	182,000 cy of wastewater with 1% solids	Assumed RI-reported wastewater had 1% solids.
	ND	260 cy of sediment in outfall ditch	
Rocky Branch and Bayou Meto flood plains	ND	13,700 cy of nearstream soil along Rocky Branch	Assumed volume of contaminated near-stream material based on an average 50-foot-wide; contaminated area along each side of stream sections with assumed TCDD levels ≥1 ppb. Assumed average depth of contamination was 1 foot.
		23,900 cy of nearstream soil along Bayou Meto	
Rocky Branch			
Instream sediments	1,900 cy	1,900 cy	Allowances for overexcavation and debris in channel added to FS-assumed volumes (not listed here). Assumed volume of contaminated bank material based on assuming an average stream cross section and average depth of contaminated material of 1 foot.
Bank sediments and soils	ND	3,800 cy	
Bayou Meto			
Instream sediments	10,300 cy	10,300 cy	Allowances for overexcavation and debris in the channel added to FS-assumed volumes (not listed here).
Bank sediments and soils	ND	7,500 cy	Assumed volume of contaminated material based on assuming an average stream cross section and average depth of contaminated material of 1 foot.

[a]In-place volume of contaminated material.
[b]*Offsite Remedial Investigation, Vertac Inc., Jacksonville, AR, Final Report.* EPA, December 1985.
[c]*Vertac Offsite Feasibility Study, Final Report.* EPA, June 1986.
ND = Not Determined

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Table 2-4
1990 FS Estimated Volumes of Material Considered For Remediation (sheet 1 of 2)

Area	Volume	Basis	Information Source
Sewage Collection Lines			
Sediment in active lines	10 cy	Volume estimate from sewer lamping study results for the 10,350-ft active sewer lines	1985 RI, Vol. I
Soil surrounding active lines	7,700 cy	Assumed 4-ft-by-4-ft contaminated cross section; 25% bulking factor	
Abandoned Rocky Branch interceptor and surrounding soil	3,200 cy	4,350-ft length; assumed 4-ft-by-4-ft contaminated cross section; 25% bulking factor	
Old STP			
Sludge in sludge digester	890 cy	Previous volume estimate; 40-ft diameter; assumed 19-ft sludge depth	1986 FS, Vol. I (p. 6-7)
Soil in sludge drying beds and surrounding soil	1,500 cy	267-ft-by-120-ft sampling area E-1; assumed 1-ft contaminated depth; 25% bulking factor	Hercules Inc., 1988 (p. 67)
Sediment in primary clarifiers	90 cy	Two 40-ft diameter basins; assumed 1-ft sediment depth	
Water in primary clarifiers	126,000 gallons	Assumed 7-ft water depth	
West WWTP			
Sediment in aeration basin	8,000 cy	Previous volume estimate; 3-acre basin; assumed 1.65-ft average sediment depth	1986 FS, Vol. I (p. 6-7)
Water in aeration basin	6.8 million gallons	Previous volume estimate; assumed 17-ft average water depth	1986 FS, Vol. I (p. 6-7)
Sediment in oxidation ponds	208,000 cy	Previous volume estimate; two 22-acre ponds; assumed 3-ft average sediment depth	1986 FS, Vol. I (p. 6-7)
Water in oxidation ponds	30 million gallons	Previous volume estimate; assumed 2-ft average water depth	1986 FS, Vol. I (p. 6-7)

Table 2-4 1990 FS Estimated Volumes of Material Considered For Remediation (sheet 2 of 2)			
Area	**Volume**	**Basis**	**Information Source**
Rocky Branch Flood Plain			
Soil in undeveloped residential area owned by Hercules Inc. (1.0 ppb <TCDD <5.0 ppb)	2,100 cy	Approximately 45,000 sf; assumed 1-ft contaminated depth; 25% bulking factor	1988 Fine-Grid Sampling Report
Soil in undeveloped residential area west of W. Rocky Branch and immediately south of Vertac property (TCDD >5.0 ppb)	400 cy	Approximately 8,600 sf; assumed 1-ft contaminated depth; 25% bulking factor	1988 EPA Region 6 sampling results
Soil in undeveloped residential area west of W. Rocky Branch (1.0 ppb <TCDD <5.0 ppb)	1,600 cy	Approximately 35,000 sf; assumed 1-ft contaminated depth; 25% bulking factor	1988 EPA Region 6 sampling results

sections included in the 1986 FS. EPA determined that remediation of Rocky Branch Creek or Bayou Meto is not necessary to protect human health (see Appendix A). These sediments and creek banks are not included in the quantities to be remediated.

TARGET CLEANUP AREAS AND ACTION LEVELS

The ATSDR reviewed the Vertac off-site RI report and assessed the human health significance of the contamination and the need for off-site cleanup. Based on this evaluation, ATSDR developed guidelines and criteria for remediation of TCDD-contaminated materials in the Vertac off-site area. The following levels were derived from ATSDR recommendations (the ATSDR memorandum is included as Appendix B).

- **Wastewater Collection System.** Sewer lines indicated in the RI to have TCDD concentrations equal to or greater than 1.0 ppb require remediation. This action level was chosen because the contaminants in the sewer line could migrate downstream and contaminate the wastewater treatment facilities, Bayou Meto, and nearby flood plains.

- **Old Sewage Treatment Plant.** TCDD-contaminated sludges, wastes, soils, and sediments in the abandoned facilities would be remediated so that an action level of 5.0 ppb TCDD is not exceeded. The ATSDR recommended an action level of 5 to 7 ppb TCDD for soils in and around the abandoned sewage treatment facilities if the following conditions were imposed:

    - The site must not be developed for agricultural or residential use

- The use and activities of the site must not become associated with the production, preparation, handling, consumption, or storage of food, other consumable items, or food-packaging materials

- The site soils must be protected from erosion that would uncover or transport TCDD that could cause unacceptable human exposure at a future date

- **West Wastewater Treatment Plant.** An action level of 5 to 7 ppb was recommended for the aeration basin, oxidation ponds, outfall ditch, and peripheral land zoned for manufacturing. This action level is subject to the same conditions listed above for the Old STP.

- **Flood Plain--Residential and Agricultural.** An action level of 1.0 ppb TCDD would be adopted for residential and agricultural areas.

- **Flood Plain--Nonresidential and Nonagricultural.** Nonresidential and nonagricultural areas in the flood plain (such as woodlands, industrial, and commercial areas) that are not subject to erosion and transport processes would have an action level of 5 ppb TCDD. If the areas are subject to erosion and transport processes (lack sufficient ground cover to inhibit erosion), the action level would be 1.0 ppb.

- **Rocky Branch and Bayou Meto Sediments.** Assuming a continued and effective State advisory discouraging ingestion of fish, the less than 0.3 ppb to 2.3 ppb TCDD levels in the sediment should not pose an unacceptable health threat.

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ENDANGERMENT ASSESSMENT

1986 ENDANGERMENT ASSESSMENT

An endangerment assessment (EA) was conducted to support the 1986 FS (U.S.EPA, June 1986). The objective of the EA was to evaluate the potential health and environmental effects if no remedial action is taken at the Vertac site. It defines the current or potential future exposures and risks attributable to contaminants at the site, primarily TCDD.

The EA includes a discussion of the 1984 RI data and how they are used, including soil, sediment, and fish sampling data. In some cases, chlorophenoxy herbicides, chlorinated benzenes, and chlorinated phenols were analyzed in addition to TCDD.

Historical data for the site were also considered to identify contamination trends. Concentrations of compounds identified in soils and sediments exceeded expected or normal concentrations for the area compared to background concentrations in the investigation area.

A discussion of the potential for migration of TCDD from the sewer system, Rocky Branch Creek, and Bayou Meto was included. The EA concluded that TCDD has the potential to migrate out of the sewage treatment plant, will adsorb onto soils and sediments, and can be transported in the creek beds and flood plains.

Potential exposure pathways to contaminated media include direct dermal contact or ingestion of sediments or soils originating from the sewer system, Rocky Branch Creek, Bayou Meto, or the flood plains; inhalation of volatilized organics, if any, from contaminants in the sewer system, creek, or flood plain sediments or soils; ingestion of fish and other aquatic organisms from Rocky Branch Creek or Bayou Meto; and ingestion of agricultural products that have been grown in contaminated soils.

From the estimate of intakes, and considering various exposure scenarios, risks were quantified.

A summary of the 1986 EA is presented in Table 2-5. The scenario of residential use of the flood plain and Rocky Branch Creek present the highest estimated risks for ingestion of TCDD contaminated soils. This scenario assumes children between the ages of 1.5 and 3.5 consume 10 grams of soil per day, from 3.5 to 5 years, 1 gram per day, and adults consume 0.1 gram per day.

For sediments found in the sewer system, if daily contact were to occur along with ingestion of 0.1 gram of soil per day, resulting risks could be as high as 10^{-3} in areas of maximum concentration. It is unlikely that daily contact with sediments would occur, even during cleaning and maintenance activities. Risks presented in this scenario represent a conservative "worst-case" approach to estimating actual health risks.

Sediments in the in-stream and near-stream areas of Rocky Branch Creek and Bayou Meto present a minor public health risk from direct contact with contaminated sediments under the recreational setting using the given assumptions. Risks may be present to aquatic organisms from contaminated sediment, but this pathway is not quantifiable. The interaction between TCDD in sediments and water is not known. Some solubilization may be possible over time. Aquatic organisms may bioconcentrate TCDD up to 30,000 times the surrounding water concentration. Bottom feeders may ingest TCDD contaminated sediments directly during feeding. Data are insufficient to determine the effects of TCDD on aquatic organisms, as fish have been found with over 850 ppb in their tissues with no apparent adverse effects.

Table 2-5
Summary of Site Problems and Associated Risk (sheet 1 of 2)

Contaminated Media	Pathway	Assessment
Sewer System Sediments	Direct/Ingestion	Risk ranges from 10^{-3} to 10^{-6} using occupational settings. Contact with sediments in the system on a daily basis is unlikely.
	Dermal	Was not quantified, may act to increase total risk. This is the most likely pathway for worker exposure to sediments within the sewer system.
	Inhalation	Was not quantified, may act to increase total risk. Inhalation of volatiles is a possibility. Quantification of volatiles was not done in the RI.
	Indirect/Ingestion, Dermal, Inhalation	Was not quantified. Could occur through overflow, backflow, exfiltration, etc. However, it is anticipated to be a minor risk.
	Migrating to creeks	Was not quantified. Anticipated to present a substantial risk to environment.
Rocky Branch Sediments	Direct/Ingestion	Risks range from 10^{-3} to 10^{-4} using the residential scenario and Kimbrough estimates of childhood soil intake. Risk ranges from 10^{-6} to 10^{-7} using the recreational scenario, 0-3" sediment depth and any age group.
	Dermal	Pathway was not quantified. May act to increase the total risk.
	Indirect/Secondary Contact (pets, etc.)	Pathways not quantified. Limited risk anticipated.
	Aquatic Uptake	Pathway not quantified. Data not available to determine risk to aquatic life.

Table 2-5 **Summary of Site Problems and Associated Risk** (sheet 2 of 2)		
Contaminated Media	**Pathway**	**Assessment**
Bayou Meto Sediments	Direct/Ingestion	Risk ranges from 10^{-5} to 10^{-7} using the recreational scenario, 0-3" sediment depth and any age group. Risk is about the same for all sediment depths.
	Dermal	Pathway was not quantified. May act to increase the total risk.
	Indirect/Secondary Contact (pets, etc.)	Pathways not quantified. Limited risk anticipated.
Fish	Direct/Ingestion	Risk ranges from 10^{-3} to 10^{-4} using the adult consumption setting. Risk is lower using TCDD concentrations in fish below 2.5 miles downstream of the confluence with Rocky Branch Creek
	Dermal	Pathway not quantified. Limited risk anticipated.
Flood plains	Direct/Ingestion	Risk ranges from 10^{-3} to 10^{-5} using the residential scenario and Kimbrough estimates of childhood soil intake. Risk ranges from 10^{-6} to 10^{-8} using the recreational scenario, 0-3" sediment depth and any age group. Risk is slightly higher for the 6-9" soil depth due to one maximum concentration (10^{-5}).
	Dermal	Pathway was not quantified. May act to increase the total risk.
	Inhalation	Pathway was not quantified, anticipated to be minor increase to total risk. Dust entrainment of soils in the flood plain not anticipated to be high due to dense vegetative cover.
	Indirect/Leaching to Groundwater	Not quantified. Considered not a major risk due to mobility of TCDD. No data available to assess pathway.

Consumption of fish from the bayou near the confluence with Rocky Branch Creek presents a potential risk between 10^{-3} to 10^{-4} excess cancers. Further downstream the risk drops to 10^{-4} to 10^{-5}.

Other contaminants that were detected but were not quantified may add to the risk presented by media at the site.

In addition, many of these pathways are additive; for example, a sewage treatment plant worker could also use the area for recreation, and consume fish from the Bayou. The potential risk from all exposure routes would have to be added to determine the cumulative risk.

REVISED RISK ASSESSMENT

The 1986 EA was updated to support the current FS and to reestimate off-site risks based on the most recent TCDD data and current EPA exposure and risk assessment guidelines. While the 1986 EA addressed several media and both TCDD and non-TCDD compounds, this update focuses specifically on ingestion of TCDD-contaminated soils and sediments. This exposure scenario is the most relevant to the current FS and provides the baseline upon which remedial alternatives can be evaluated.

Post-RI data are available for several of the off-site areas, including the Old STP, WWTP, Rocky Branch Creek and Bayou Meto sediments, and flood plain soils from Rocky Branch Creek and Bayou Meto. This revised risk assessment includes only those areas where concentrations have changed significantly since the 1984 RI. These areas include the Old STP, WWTP, and Rocky Branch Creek flood plain.

The exposure parameters used to estimated cancer risks in the 1986 EA included: lifetime average soil ingestion rate (LASI); fraction of the year that exposure occurs;

and fraction of the chemical that is absorbed in the gut. LASI rates were estimated for occupational, recreational, and residential settings. The LASI for the residential setting has been revised based on EPA's 1989 Risk Assessment Guidance (EPA 1989). The LASI used for the residential setting in the 1986 EA was 0.0281 g/kg/day. The revised residential LASI is 0.0022 g/kg/day. The primary difference in these estimates is the reduction in the soil ingestion rates during the childhood years. No new information is available to revise the LASI for the occupational and recreational settings. Similarly, the information used in the 1986 EA to estimate the fraction of the year when exposure occurs and the absorption factor is current and, therefore, has not been revised.

The cancer potency factor used in the 1986 EA was 156,000 $(mg/kg\text{-}day)^{-1}$. This continues to be the cancer potency factor used in EPA risk assessments for 2,3,7,8-TCDD (EPA, 1989).

The following subsections present revised exposure and risk estimates for each of the offsite areas.

Sewage Collection Lines

The sewer collection lines have not been sampled since the 1984 RI sampling, where the maximum concentration was found to be 200 ppb TCDD. The occupational exposure setting used in 1984 has not changed and, therefore, the risk estimates for the collection lines have not changed.

Old STP

As part of the 1988 fine-grid sampling conducted by Hercules, 73 surface (0 to 3 inch) samples were composited and analyzed from the sludge drying beds. The TCDD concentration in this composite sample was 2.79 ppb. This compares to the 1984

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maximum and average surface concentrations of 0.77 and 0.39 TCDD, respectively. Using the same occupational exposure parameters, the risks associated with ingestion of sludge from the drying beds would be 4 x 10^{-5} based on the 1988 data.

The only other areas of the Old STP where post-RI data are available are the perimeter of the sludge drying beds and the soil surrounding the clarifiers (available from 1988 fine-grid sampling). Neither of these specific areas were sampled during the RI. Sixty-six samples were composited from the perimeter of the sludge beds and 39 from the clarifier area. The concentrations in these composite samples were 1.01 and were 0.307 ppb TCDD, respectively. The risks associated with these areas, using the occupational exposure setting, would be 1.5 x 10^{-5} and 4.5 x 10^{-6}, respectively.

WWTP

The 1984 RI data showed maximum and average concentrations from the aeration basin of 37.9 and 20.2 ppb TCDD, respectively. In 1988, composite samples were taken in each of the four quads of the aeration basin. Each composite consisted of 6 samples. The highest composite sample was 2.83 ppb TCDD. Using the occupational exposure parameters, the risks associated with aeration basin soils would be 4.1 x 10^{-5}.

The north oxidation pond showed maximum and average concentrations of 3.6 and 2.8 ppb TCDD, respectively, in 1984. In 1988, two composite samples were taken from the north pond. The highest composite sample showed a TCDD concentration of 0.97 ppb. The risk associated with this concentration would be 1.4 x 10^{-5}.

The maximum and average concentrations from the south pond in 1984 were 1.3 and 1.2 ppb TCDD, respectively. In 1988, both composite samples showed nondetectable concentrations. At the detection limit of 0.3 ppb TCDD, the risk would be 4.3 x 10^{-6}.

Rocky Branch Creek Flood Plain

In 1988 and 1989, EPA sponsored sampling of the flood plain soils along the west leg of Rocky Branch Creek. Samples were composited from grids that were approximately 20 feet by 250 feet. The highest composite sample showed a concentration of 9.6 ppb TCDD. The risk associated with this concentration, using the revised residential LASI, is 5.7×10^{-4}.

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Section 3

Identification and Screening of Technologies

Section 3

IDENTIFICATION AND SCREENING OF TECHNOLOGIES

This study followed a four-step process to identify and screen technologies for assembly into sitewide remedial action alternatives. The general process is outlined in the *Guidance For Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA, October 1988). The four steps involved are to:

- Establish remedial action objectives
- Identify general response actions and remedial technologies for each medium of interest
- Identify technology process options and screen technologies/options based on technical implementability
- Evaluate screened process options based on effectiveness, institutional implementability, and relative cost

"General response action," "remedial technology," and "process option" refer to three tiers in a hierarchical system for describing remedial action processes. General response actions are the most general; process options are the most specific. For example, one general response action is containment; one of several possible remedial technologies in the containment category is capping; and one of several possible process options in the capping technology is a multilayer cap. The term "primary remedial technology" refers to a remedial technology or process option which, if implemented, would be instrumental in effecting site remediation. This term does not include processes that support primary cleanup activities.

The rest of this section details the application of the four-step identification and screening process in this study.

IDENTIFICATION OF REMEDIAL ACTION OBJECTIVES

The remedial action objectives for the Vertac off-site area are based primarily on the TCDD action levels recommended by ATSDR and EPA's specially-formed dioxin group (see Appendix B) and the 1989 EPA memorandum to ATSDR (Appendix A). The remedial action objectives are stated below. The first three concern protection of human health, the fourth concerns environmental protection, and the fifth is a requirement for federal funding for the new Jacksonville sewage treatment facility.

1. For residential and agricultural areas, prevent long-term ingestion of contaminated soils with TCDD concentrations above 1.0 ppb.

2. For nonresidential/nonagricultural or undeveloped residential areas (Old STP, West WWTP, undeveloped Rocky Branch Creek flood plain areas), prevent direct public contact with contaminated soils containing TCDD concentrations above 5.0 ppb.

3. Follow the recommendations contained in the January 26, 1989, EPA memorandum regarding protection of human health in Rocky Branch Creek and Bayou Meto.

4. Prevent migration of TCDD-contaminated sediments into the waterways and surrounding flood plains.

5. Prevent migration of TCDD-contaminated sediments through the sewage collection lines to the new Jacksonville sewage treatment facility.

IDENTIFICATION OF GENERAL RESPONSE ACTIONS AND TECHNOLOGIES

Hazardous waste data base and literature resources were used in addition to the 1986 FS to identify general response actions and technologies that could satisfy the remedial action objectives for the off-site areas under consideration in this study. Table 3-1 lists the identified general response actions and the remedial action objectives that each action could potentially meet.

Table 3-1
Remedial Action Objectives Potentially Met by the General Response Actions

	Objectives[a] Potentially Met				
General Response Action	**Collection Lines**	**Old STP**	**West WWTP**	**Rocky Branch Flood Plain**	**Rocky Branch and Bayou Meto Sediments**
No Action	None	None	2	None	3
Institutional Controls	None	None	4	1,2	3
Containment	5	2,4	4	1,2,4	None
Removal	5	2,4	4	1,2,4	None
Treatment	5	2,4	4	1,2,4	None
Disposal	5	2,4	4	1,2,4	None
Monitoring	None	None	2	None	3

[a]Numbers correspond to objectives (described in text).

Figure 3-1 lists the general response actions and corresponding remedial technologies that may be applicable for at least one of the off-site areas. Generic descriptions for the remedial technologies are also provided.

TECHNOLOGY/PROCESS OPTION IDENTIFICATION AND SCREENING

Figure 3-2 shows process option variants specific to the remedial action technologies. Generic process option descriptions are provided. These process options and technologies were screened based on technical implementability to eliminate any that would not be applicable as a primary remediation activity for at least one of the off-site areas.

Factors considered to assess technical implementability included:

- Ability to construct and operate the technology
- Reliability of the technology
- Ease of implementing additional remedial action, if necessary
- Ability to monitor effectiveness of remedy
- Availability of treatment, storage, and disposal services and capacity
- Availability of necessary equipment and specialists
- Availability of prospective technologies

The diagonal lines on Figure 3-2 mark the technologies and process options eliminated as primary remediation activities because they would not be implementable at any off-site area.

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GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	DESCRIPTION
NO ACTION	NONE	NO ACTION; REMEDIAL RESPONSES INITIATED AT SITE ARE ABANDONED; MONITORING.
INSTITUTIONAL CONTROLS	ACCESS AND USE RESTRICTIONS	EXAMPLES INCLUDE LEGAL RESTRICTIONS ON DEEDS TO REGULATE LAND USE; FENCES TO REGULATE SITE ACCESS.
	RELOCATION OF RESIDENTS	RESIDENTS ARE RELOCATED ON EITHER A TEMPORARY (APARTMENT OR MOTEL) OR A PERMANENT (PURCHASE OF RESIDENCE) BASIS.
CONTAINMENT	HORIZONTAL BARRIERS	LOW-PERMEABILITY MATERIAL IS PLACED INTO VOID SPACES TO REDUCE THE VERTICAL PERMEABILITY OF THE IN SITU SOIL.
	SURFACE CONTROLS	SURFACE SEALING, GRADING, SOIL STABILIZATION, REVEGETATION, AND DIVERSION/COLLECTON PROCESSES ARE IMPLEMENTED TO REDUCE SITE RUNON/RUNOFF, SURFACE WATER INFILTRATION AND EROSION, AND TO STABILIZE SURFACE SOILS.
	DUST AND VAPOR SUPPRESSION	TARPS, SOIL COVERS, SPRAYS, OILS, ETC. ARE APPLIED TO SUPPRESS DUST AND NON-POINT-SOURCE VAPOR.
REMOVAL	DRUM & DEBRIS REMOVAL & DEMOLITION	DRUMS AND/OR DEBRIS ARE REMOVED BY VARIOUS MECHANICAL MEANS, E.G., CRANES AND OTHER STANDARD CONSTRUCTION EQUIPMENT. STRUCTURES ARE DEMOLISHED USING STANDARD CONSTRUCTION EQUIPMENT TO REDUCE POTENTIAL EXPOSURES.
	EXCAVATION	CONTAMINATED SOIL, SEDIMENT, SLUDGES AND OTHER SOLIDS ARE REMOVED WITH STANDARD CONSTRUCTION EQUIPMENT.
	BULK LIQUID REMOVAL	BULK LIQUIDS IN OPEN PITS, OPEN PONDS, TANKS, DRUMS, ETC., ARE REMOVED BY A VARIETY OF METHODS INCLUDING , DREDGING, BAILING AND PUMPING.
	DECONTAMINATION	CONTAMINATED BUILDINGS OR OTHER STRUCTURES ARE WASHED WITH A SUBSTANCE THAT REMOVES CONTAMINANTS UPON RINSING. OFTEN DECONTAMINATION IS DONE WITH A PRESSURIZED STREAM.
TREATMENT	SOLIDS PROCESSING	SOLIDS PROCESSING PREPARES THE WASTE FOR FURTHER TREATMENT OR DISPOSAL BY SIZE REDUCTION OR CLASSIFICATION OR MATERIAL SEPARATION.
	SOLIDS TREATMENT	SOILS, SEDIMENTS, SLUDGES, AND OTHER SOLIDS ARE PHYSICALLY OR CHEMICALLY TREATED TO REMOVE THE HAZARDOUS CONSTITUENTS OR CONVERT THE CONSTITUENTS TO NONHAZARDOUS SUBSTANCES.
	SOLIDIFICATION, FIXATION, STABILIZATION	STABILIZATION AND FIXATION PROCESSES MAINTAIN HAZARDOUS CONSTITUENTS IN THEIR LEAST TOXIC AND/OR LEAST SOLUBLE FORM. SOLIDIFICATION PRODUCES A MONOLITHIC BLOCK OF TREATED WASTE WITH HIGH STRUCTURAL INTEGRITY.
	SOLIDS DEWATERING	SOLID/LIQUID SEPARATION CLARIFIES LIQUID STREAMS, RECOVERS SOLIDS AND LIQUIDS, OR REMOVES EXCESS LIQUID FROM SLUDGE PRIOR TO DISPOSAL.
	CHEMICAL TREATMENT	HAZARDOUS LIQUIDS ARE ALTERED BY CHEMICAL REACTIONS TO DETOXIFY HAZARDOUS COMPOUNDS OR TO CONVERT THE COMPOUNDS TO A MORE EASILY TREATED FORM.
	BIOLOGICAL TREATMENT	A CULTURE OF MICROORGANISMS METABOLIZES BIODEGRADABLE ORGANIC COMPOUNDS.
	IN SITU TREATMENT	PHYSICAL, CHEMICAL, AND BIOLOGICAL PROCESSES ARE EMPLOYED TO TREAT CONTAMINATED SOIL, SOLID WASTES OR GROUNDWATER IN PLACE.
	THERMAL TREATMENT	WASTE MATERIAL IS EXPOSED TO HIGH TEMPERATURES TO TRANSFORM THE HAZARDOUS COMPOUNDS INTO INNOCUOUS OR LESS HARMFUL SUBSTANCES.
DISPOSAL	TEMPORARY STORAGE	HAZARDOUS MATERIAL IS TEMPORARILY STORED IN LANDFILLS, SURFACE IMPOUNDMENTS, WASTE PILES, OR CONTAINERS/TANKS.
	LANDFILL	SOLID WASTES ARE PERMANENTLY DISPOSED OF IN A LANDFILL. LANDFILLS CANNOT ACCEPT LIQUID WASTES.
MONITORING	MONITORING	SHORT-AND/OR LONG-TERM MONITORING IS IMPLEMENTED TO RECORD SITE CONDITIONS AND CONTAMINATION LEVELS.

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FIGURE 3-1
REMEDIAL TECHNOLOGY DEFINITIONS
Vertac Off-Site FS
Jacksonville, Arkansas

GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
No Action	None	None	No action	Required for consideration by NCP. Does not reduce contamination, potential for exposure or migration. Potentially applicable for contaminated areas below cleanup levels.
Institutional Controls	Access and Use Restrictions	Deed Restrictions	Notices placed in deeds for property within potentially contaminated areas to warn against property use.	Useful for preventing exposure before, during, and after remediation. Do not reduce contaminant levels or potential for migration.
		Fences, Public Notification	Security fences installed around potentially contaminated areas to limit access.	
	Relocation of Residents	Temporary	Move residents to a motel or apartment. Pay for most additional out-of-pocket expenses for a finite period of time.	*Not applicable because most contaminated materials are* not located in, or have been removed from, developed residential areas. Remaining soils have (will have) low contaminant concentrations.
		Permanent	Move residents to a new residence. Pay for out-of-pocket moving costs, temporary housing and meals, utility connections, mortgage purchase, and closing costs.	
Containment	Capping	Native Soil	Uncontaminated native soil placed over contaminated areas. Soil should minimize infiltration of precipitation.	Potentially applicable for in situ contaminated soils, sludge drying beds, *oxidation ponds (after draining), clarifiers,* sludge digestors, aeration basins. Concrete filling or plugging may be applicable for wastewater collection lines. Capping is not applicable for some treatment plant structures and debris.
		Clay Cap	Compacted clay placed over contaminated areas. Clay should be covered by at least a foot of silty sand or sandy soil to maintain the integrity of the clay cap.	
		Synthetic Membranes	Synthetic membrane placed over prepared soil or geotextile surface that is over a contaminated area. The membrane is seamed by a variety of methods. The membrane must be compatible with the wastes present.	
		Sprayed Asphalt	Sprayed asphalt is placed over contaminated areas and covered with soil or opaque reflective paint to protect the asphalt from ultraviolet light and to retard oxidation.	
		Asphaltic Concrete	Asphalt for paving grades or special blends mixed with well graded, crushed aggregate, placed over contaminated areas.	
		Concrete Cap	Concrete placed over prepared contaminated area. Fill settlement must be evaluated in considering a concrete cap design.	
		Multilayered Cap	Cap may be composed of natural soils, soil *admixtures, clay, synthetic membranes, spray-on* asphalts, asphaltic concrete, or portland cement concrete and placed over contaminated areas. If properly designed, will meet RCRA requirements.	
		Grouting	*Abandoned wastewater collection lines and manholes* are filled with grout.	
		Chemical Sealants/Stabilizers	Water-dispersible emulsions and/or resins placed over contaminated areas to form a crust that *reduces water and wind or dust erosion. Most are* nontoxic to plants and animals. Temporary cover only.	
	Surface Controls	Surface Sealing	Cover materials and seal techniques implemented to stabilize waste deposits and to prevent surface water infiltration, control erosion, and isolate and contain the wastes. Similar to capping.	Potentially applicable for media with contamination below action levels or for remediated areas. Do not reduce contamination.
		Grading	Reshaping of topography to manage surface water. Infiltration and runoff to control erosion.	
		Soil Stabilization	Chemical stabilizers sprayed on bare soils or *mulches to coat, penetrate, and bind together the* particles. Chemical stabilizers include latex emulsions, plastic films, oil-in-water emulsions, and resin-in-water emulsions.	
		Revegetation	A systematic revegetation plan includes selection *of a suitable plant species, seedbed preparation,* seeding/planting, mulching and/or chemical stabilization, fertilization, and maintenance.	Potentailly applicable in support of excavation or other remedial activities. Not a primary remedial technology.
		Diversion and Collection Systems	Diversion and collection structures installed upslope or at perimeter of the site to control *drainage of stormwater runoff. System can also be* implemented to collect contaminated surface water for remediation.	Not applicable for cleaning up contaminated soils.

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Not retained for consideration as a primary remedial technology

FIGURE 3-2
TECHNOLOGY PROCESS OPTION SCREENING
Vertac Off-Site FS
Jacksonville, Arkansas

GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Containment *(continued)*	Dust and Vapor Suppression	Water	Water sprayed over area of concern to prevent dust generation.	Potentially applicable in support of excavation or other remediation activities. Not a primary remedial technology.
		Organic Agents/Polymers/Foams	Organic agents/polymers/foams sprayed over area of concern to prevent dust/vapor generation.	
		Membranes/Tarps	Membranes or tarps are spread over area of concern to prevent dust/vapor generation.	
		Hygroscopic Agents	Hygroscopic salts absorb moisture into the soil in which they are mixed.	
Removal	Debris Removal & Demolition	Forklifts and Attachments	Used for moving drums on pallets.	Potentially applicable for removal of debris in conjunction with ultimate treatment/disposal process and for demolition of old STP structures.
		Cranes and Attachments	Used with wrecking balls for demolition of wall or concrete pads, clamshells for lifting or ripping, wires or platforms for lifting, and hoppers, buckets, and other devices for carrying.	
		Handtools	Used for light demolition and moving debris.	
		Backhoes and Attachments	Used for excavation, trenching, pulling down structures, and loading material.	
		Cutting Devices	Used to cut steel--rebar, beams, drums, tanks, siding, etc.	
	Solids Removal	Soil	Removal of contaminated solids can use ordinary construction equipment (backhoes, bulldozers, and front-end loaders).	Potentially applicable in conjunction with ultimate treatment/disposal process.
		Sludge	Removal of contaminated semi-solids requires working on mats or floating equipment. A toothless bucket is recommended over draglines or clamshells. Transportation and disposal methods must consider the water associated with the semi-solids.	
		Sediment	Removal of contaminated sediments requires floating equipment or operation of equipment on the bank. Hydraulic dredges, barge-mounted pumps, vacuum trucks, and pneumatic dredges are used for excavation. Generally bulk liquid removal will also be required.	
	Bulk Liquid Removal	Pumps	Used to remove large amounts of liquid. Liquid must be free of debris.	Potentially applicable for removing water from contaminated basins, ponds, etc. in conjunction with ultimate treatment/disposal process. Not a primary remedial technology.
		Industrial Vacuum	Used to pull liquids directly into a truck. "Super suckers" can vacuum extremely viscous material and solids. Volatiles can pose a health and safety problem.	
		Gravity/Siphon	Used to remove liquids from tanks. Not recommended for flammable, reactive, or shock-sensitive materials.	
		Bailing	Used to remove small amounts of liquid or sludge.	Not feasible because of large volume of liquid.
	Decontamination	Washing	Contaminated buildings or other structures washed with a substance that removes contaminants upon rinsing. Often decontamination is done with a pressurized stream.	Potentially applicable in conjunction with ultimate treatment/disposal of decontamination materials. Not a primary remedial technology.
		Mechanical Operations	Contamination is removed mechanically by sandblasting or similar means	

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Not retained for consideration as a primary remedial technology

FIGURE 3-2 (continued)
TECHNOLOGY PROCESS OPTION SCREENING
Vertac Off-Site FS
Jacksonville, Arkansas

GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Treatment	Solids Processing	Crushing and Grinding	Brittle wastes stressed by impact beyond their elastic limit and broken by heavy, slow-moving equipment.	Potentially useful in support of other treatment process (eg., incineration); not feasible alone because do not reduce contamination. Not a primary remedial technology.
		Shredding and Chopping	Non-brittle wastes are reduced to uniform size by mechanically shredding, chopping, crumbling, etc.	
		Screening	Solid wastes, including sediments, and debris are separated according to size by screens. Generally applicable to coarse material (>200 microns).	Not applicable unless required by a specific treatment process.
		Classification	Wastes hydraulically sized using specific gravity differences. Generally applicable to finer-sized particles (<200 microns).	
	Solids Treatment	Solvent Leaching	Solvent infiltrates contaminated solid, leaching out contaminants that are soluble in the selected solvent.	Not feasible because of difficulty of achieving target TCDD levels. Requires preprocessing of soils, multiple washings, and treatment/disposal of contaminant-containing solvent.
	Solidification, Fixation, Stabilization	Sorption	An inert, nondegradable, nonreactive sorbent added to liquid or sludge to soak up moisture and produce a soil-like material.	Not applicable because TCDD is already sorbed to soils/ sediments.
		Pozzolanic Agents	Lime and fine-grained siliceous material added to aqueous waste to produce a concrete-like solid.	Potentially applicable
		Encapsulation	Material is encapsulated by either coating the individual particles or enclosing entire mass in a jacket of inert material. Applicable for extremely dangerous or radioactive wastes.	Not feasible because of large volume of contaminated material.
	Solids Dewatering	Centrifuges	Sludge dewatered by centrifugal force. Centrifuges are used when space is limited or where sludge incineration/disposal is required.	Potentially applicable for dewatering contaminated sludges from treatment plant in conjunction with ultimate treatment or disposal process.
		Filter Presses	Sludge passed into press under pressure, water passes through filter cloth while solids form a cake on the filter cloth surface.	
		Drying Beds and Lagoons	Sludge placed on sand layered over gravel. Water in the sludge evaporates and drains.	
		Sludge Dryers	Contaminated sludge or soil heated in equipment which allows mixing. Aqueous liquids evaporated from solids into the gas stream.	
	Physical/Chemical Treatment	Chemical Oxidation	Oxidizing agents added to wastes for oxidation of cyanide, heavy metals, unsaturated organics, sulfides, sulfites, phenolics, pesticides, aldehydes, and aromatic hydrocarbons to less toxic oxidation states.	May require solvent extraction or pulverization of soil to form a slurry; experimental process, full-scale reliability unknown.
		Organic Chemical Dechlorination	Chemical reagents or catalysts added to wastes to remove chlorine atoms from chlorinated hydrocarbons. Not applicable to aqueous wastes. Experimental process option.	Although some results are favorable, not proven reliable for full-scale operation.
		Photolysis	Sunlight, fluorescent lamps, or mercury arcs applied to liquid or gaseous waste stream to promote the photodegradation of the contaminant. Experimental process option.	Requires prior solvent extraction of contaminants from soil; experimental process, not proven reliable for full-scale operation.
		Irradiation	Substance exposed to a radiation flux field to initiate chemical reactions, induce biological changes, or modify chemical and physical properties of the substances. Applicable to stack gases.	Requires prior solvent extraction of contaminants from soil; experimental process, not proven reliable.
		Chemical Reduction	Reducing agents or catalysts added to wastes for reduction of metals to less soluble, more stable forms.	Not applicable to organic contaminants of interest.
		UV/ozone oxidation	A combination of ultraviolet light and ozone are used to oxidize organic contaminants.	Requires prior solvent extraction of contaminants from soil; experimental process, not proven reliable for TCDD destruction.
		Carbon Adsorption	Contaminated liquid or gas stream passed over adsorbent that removes contaminants.	Not applicable for treatment of contaminated soil because requires prior solvent extraction of contaminants. TCDD-contaminated carbon cannot be regenerated so must be treated as hazardous waste. Potentially applicable for treatment of contaminated liquid. Not a primary remedial technology.

Not retained for consideration as a primary remedial technology

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FIGURE 3-2 (continued)
TECHNOLOGY PROCESS OPTION SCREENING
Vertac Off-Site FS
Jacksonville, Arkansas

GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Treatment (continued)	Biological Treatment	New Biotechnologies	Application of pure cultures, genetically modified microorganisms, or purified enzymes to biodegade organic contaminants.	Promising results but not proven effective for full-scale treatment of TCDD-contaminated materials.
		Aerobic Processes	Organic wastes oxidized through the use of a mixed culture of organisms in aerobic conditions.	
		Anaerobic Processes	Organic compounds oxidized through the use of a mixed culture of organisms in anaerobic conditions.	
		Facultative Processes	Organic compounds removed from wastewaters through the use of a mixed culture of organisms in both aerobic and anaerobic conditions.	
		White Rot Fungus	White rot fungus used to biotransform organic contaminants to less toxic compounds.	
	In Situ Treatment	Oxidation	Ozone or hydrogen peroxide applied in water solutions to the soil to promote the oxidation of organics. Conceptual process option.	Not applicable to contaminated soils/sediments.
		Biodegradation	Microbiological degradation, detoxification, and mineralization of hazardous substances is enhanced with respect to electron acceptors, nutrient levels, moisture content, pH, and temperature.	Potentially applicable for WWTP facilities.
		Vitrification	Graphite electrodes placed in a square array. Electric current passes through electrodes creating high temperatures that melt the soil or waste solids into a block of glasslike material.	Not applicable for shallow, widespread, contaminated soils.
		Other In Situ Treatment	Other treatments include immobilization, polymerization, and photolysis. Generally experimental process options.	Not applicable
	Thermal Treatment	Incineration	Hazardous materials thermally destroyed in a controlled, oxygen-sufficient environment. Generally, products include carbon dioxide, water, and ash. Many types of incinerators with varying capabilities exist.	Potentially applicable
		Pyrolysis	Hazardous materials thermally destroyed in an oxygen-deficient environment.	Potentially applicable
		Supercritical Water Oxidation	Organic contaminants are oxidized by oxygen or air in water above its critical temperature and pressure (374°c and 218 atm).	Not proven reliable for full-scale treatment of TCDD-contaminated materials.
		Wet Air Oxidation	Organics are oxidized in water under high temperatures (150-350°c) and pressures (500-2500 psig).	
		Molten Salt Combustion	Chlorinated hydrocarbon wastes are oxidized in a molten salt bath at 800-1000°c to CO_2, water, and sodium chloride.	
		Microwave Plasma Destruction	Organic contaminants are broken down into smaller compounds when combined with partially ionized gas produced by microwave-induced reactions.	

Not retained for consideration as a primary remedial technology

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FIGURE 3-2 (continued)

TECHNOLOGY PROCESS OPTION SCREENING

Vertac Off-Site FS
Jacksonville, Arkansas

GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Disposal	Temporary Storage	Temporary Burial	Hazardous materials are temporarily buried (onsite) until permanent treatment or disposal.	Not feasible because contaminated soils have been excavated and bagged, awaiting treatment.
		Surface Impoundments	Surface impoundments are used to store or treat liquid and sludge-type waste. Also known as ponds, lagoons, liquid trenches, evaporation ponds, treatment ponds, aeration pits, and stabilization basins.	Not applicable for contaminated solids.
		Waste Piles	Waste piles are used for temporary storage of solid wastes.	May be used to store waste until treatment; not feasible alone because contamination not reduced
		Containers/Tanks	Containers are used to temporarily store and transport wastes. Tanks are used to temporarily store liquid wastes prior to treatment or disposal.	May be used to store waste until treatment; not feasible alone because contamination not reduced
	Landfill	RCRA Landfill	Solid hazardous wastes are permanently disposed of in a RCRA-permitted landfill. RCRA landfills cannot accept liquid hazardous waste.	Potentially applicable
		Non-RCRA Landfill	Solid nonhazardous wastes are permanently disposed of in a non-RCRA landfill. Landfills cannot accept liquid wastes.	Not feasible for hazardous waste.
		Onsite Consolidation	Consolidation of removed, contaminated materials on-site.	Potentially applicable
Monitoring	Monitoring	Monitoring	Short-and/or long-term monitoring is implemented to record site conditions and contamination levels.	Not feasible for media with contamination in excess of action levels; potentially applicable for media within action level.

[hatched box] Not retained for consideration as a primary remedial technology

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FIGURE 3-2 (continued)

TECHNOLOGY PROCESS OPTION SCREENING

Vertac Off-Site FS
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TECHNOLOGY/PROCESS OPTION EVALUATION

Technologies and process options that survived the technical implementability screening were evaluated based on effectiveness, institutional implementability, and relative cost. Results of these evaluations are shown in Figure 3-3.

Factors considered to assess effectiveness included:

- Magnitude of residual risk
- Adequacy and reliability of controls
- Protection of community and workers during remedial actions
- Environmental impacts
- Time until remedial action objectives are achieved

Factors considered to assess institutional implementability included:

- Compliance with ARARs and other criteria, advisories, and guidelines
- Ability to obtain agency approvals
- Coordination with other agencies

For the relative cost evaluations, process options within the same technology were ranked relative to each other in terms of low, medium, or high capital and operating and maintenance (O&M) costs.

As in Figure 3-2, the diagonal lines on Figure 3-3 mark the technologies and process options eliminated from further consideration as primary remedial technologies. However, a process option eliminated as a primary remedial technology may still be employed as a supporting process. For example, RCRA landfill is screened out as a

GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	RELATIVE COST
No Action	None	None *f	Does not prevent exposure to or migration of contaminants.	Not acceptable to local/public agencies for areas contaminated above action levels.	Not applicable
Institutional Controls	Access and Use Restrictions	Deed Restrictions *d	Effective for restricting future land uses; no contaminant reduction.	Implementable, legal requirements	Low capital, low O&M
		Fences, Public Notification *bcd	Effective for limiting access; no contaminant reduction.	Implementable	Moderate capital, low O&M
Containment	Capping	Native Soil *c	Provides barrier to prevent direct contact; susceptible to erosion during flooding	Would require flood protection, restricts future land use.	Low capital, low O&M
		Clay Cap	Provides barrier to prevent direct contact; somewhat susceptible to cracking and erosion during flooding.	May require flood protection, restricts future land use.	Moderate capital, low O&M
		Synthetic Membranes	Provides barrier to prevent direct contact, not permanent- requires routine maintenance, susceptible to flood damage.	Requires flood protection, restricts future land use.	Moderate capital, low O&M
		Sprayed Asphalt	Provides hard barrier to prevent direct contact; susceptible to weathering and cracking; susceptible to erosion at edges.	Restricts future land use; may be acceptable only in non-residential areas; may not be acceptable along waterways.	Low capital, moderate O&M
		Asphaltic Concrete *b	Provides hard barrier to prevent direct contact; susceptible to weathering and cracking and erosion at edges.	Restricts future land use; may be acceptable only in non-residential areas; may not be acceptable along waterways.	High capital, moderate O&M
		Concrete Cap	Provides hard barrier to prevent direct contact; susceptible to cracking and erosion at edges.	Restricts future land use; may be acceptable only in non-residential areas; may not be acceptable along waterways.	High capital, moderate O&M
		Multilayered Cap *bcde	Provides thick barrier to prevent direct contact; least susceptible to cracking.	Restricts future land use; may not be acceptable since 4-5 feet thick.	High capital, moderate O&M
		Grouting *a	Minimizes potential for further migration and exposure.	Dependent on level of deterioration and accessibility of collection lines.	Moderate capital, low O&M
		Chemical Sealants/Stabilizers	Not permanent - temporary cover only, susceptible to erosion and weathering.	Not acceptable as a permanent cap.	Low capital, high O&M
	Surface Controls	Surface Sealing	Not permanent, precludes normal vegetaion, susceptible to erosion.	Not acceptable in residential areas.	Moderate captial, moderate O&M
		Grading	Effective for controlling erosion due to flooding, no contaminant reduction.	Implementable for flood control (e.g. berms).	Moderate capital, low O&M
		Soil Stabilization	Not permanent, effective for short-term control of erosion, no contaminant reduction.	Implementable during excavation/construction, not as a long-term remedy.	Low capital, low O&M
Removal	Solids Removal	Soil *bd	Removal of contaminated soils is very effective in preventing exposure and migration.	Implementable	High capital, low O&M
		Sludge *bc	Removal of contaminated sludges is very effective in preventing exposure and migration.	Implementable	Moderate capital, low O&M
		Sediment *abc	Removal of contaminated sediments is very effective in preventing exposure and migration.	Implementable	High capital, low O&M
	Demolition	Cranes and attachments *b	Effective in initial demolition of large structures.	Implementable	Low capital, low O&M
		Handtools *b	Effective in achieving maximum sizes for demolition.	Implementable	Low capital, low O&M
		Backhoes and attachments *b	Effective in taking down structures.	Implementable	Low capital, low O&M
		Cutting devices *b	Effective in cutting smaller metal pieces.	Implementable	Low capital, low O&M

Not retained for consideration as a primary remedial technology.

* Selected for use in assembling sitewide alternatives for the Off-site study area. Area(s) to which the retained process options pertain are: a = collection lines; b = Old STP; c = West WWTP; d = Rocky Branch flood plain; e = Onsite consolidation area; f = Bayou Meto and Rocky Branch.

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FIGURE 3-3
EVALUATION OF PROCESS OPTIONS

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GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	RELATIVE COST
Treatment	Solidification, Fixation Stabilization	Pozzolanic Agents	Moderately effective for isolating hazardous waste; some leaching may occur; fixed soil is porous; increases volume of waste material.	Solidified materials must be handled as hazardous waste.	High capital, low O&M
	Solids Dewatering	Centrifuges	Fairly effective for dewatering materials to 10-30% solids. Relatively fast process.	Implementable	Moderate capital, low O&M
		Filter Presses *abc	Very effective for dewatering a wide range of materials to 15-40% solids (30-50% for pressure filters). Relatively fast process. Requires more conditioning chemicals than other dewatering processes.	Implementable	Moderate capital, Moderate O&M
		Drying Beds and Lagoons	Effective for dewatering large volumes of materials to solids contents up to 40%. Relatively slow process unless vacuum-assisted.	Require large land surface area, low permeability liner, leachate collection, and dust control. When action is complete, liner must be removed and properly disposed of.	Moderate to high capital, Moderate to high O&M
		Sludge Dryers	Sludge drying is normally preceded by dewatering. Effective for drying materials to roughly 90% solids. Energy intensive process.	Implementable	High capital, high O&M
	In Situ Treatment	Biodegradation	Slow process, not proven reliable for achieving target levels of TCDD.	May not be acceptable to local/public agencies.	Low capital, low O&M
	Thermal Treatment	Incineration *abcd	Effective for destruction of TCDD in soil; potential emissions.	Implementable; incinerators have been certified for TCDD-destruction; residues may require delisting or downlisting.	High capital, moderate O&M
		Pyrolysis	Effective for destruction of TCDD in soil; does not require supplemental fuel; lower emissions of CO_2, CO, NOx than incineration; residues may require handling as hazardous waste.	Implementable; pyrolysis units have been permitted for dioxin-containing wastes; residues may require delisting or downlisting.	High capital, moderate O&M
Disposal	Temporary Storage	Waste Piles	Effective for temporary storage of contaminated materials prior to treatment/disposal; no containment of contaminants.	Implementable for temporary storage only for materials with TCDD levels below the 1.0 ppb treatment standard.	Low capital, low O&M
		Containers/Tanks	Effective for temporary storage of contaminated materials prior to treatment/disposal; contaminants contained.	Implementable only for short-term storage before treatment/disposal.	Moderate capital, low O&M
	Landfill	RCRA Landfill	Effective for isolating hazardous wastes.	Implementable only for materials with TCDD levels below the 1.0 ppb treatment standard.	Moderate capital, moderate O&M
		Onsite Consolidation *bd	Consolidation of low-level contaminated materials on the Vertac Plant site would effectively reduce potential for exposure and migration.	Consolidation of hazardous waste into an area on the same Superfund site is permissible; land disposal is otherwise restricted for TCDD waste. Implementable if considered consolidation, not implementable if considered land disposal.	Low capital, low O&M
Monitoring	Monitoring	Monitoring *f	Effective for evaluating remaining contaminant levels and future contamination.	Implementable	Moderate capital, moderate O&M

(hatched box) Not retained for consideration as a primary remedial technology.

* Selected for use in assembling sitewide alternatives for the Off-site study area. Area(s) to which the retained process options pertain are: a = collection lines; b = Old STP; c = West WWTP; d = Rocky Branch flood plain; e = Onsite consolidation area; f = Bayou Meto and Rocky Branch.

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FIGURE 3-3 (continued)
EVALUATION OF PROCESS OPTIONS
Vertac Off-Site FS
Jacksonville, Arkansas

primary remedial technology because of the land ban on materials with TCDD concentrations exceeding 1.0 ppb. However, as noted in the screening comments on Figure 3-3, a RCRA landfill may be applicable for disposal of materials with TCDD less than 1.0 ppb (e.g., incinerator ash).

After screening and evaluation, one or more remedial technologies and process options were chosen to represent the various technology types. The selected process options and corresponding off-site areas are indicated with an asterisk in Figure 3-3. These representative process options were used in assembling sitewide remedial action alternatives for the off-site study area (Section 4).

Section 4

Development of Alternatives

Section 4

DEVELOPMENT OF ALTERNATIVES

ASSEMBLY OF ALTERNATIVES

Using the remedial technologies and process options selected to represent the various technology types (Section 3), a variety of potential remedial actions can be identified for each area targeted for cleanup. The Vertac off-site area is complex in the number and variety of target cleanup areas; however, the number of potential remedial actions is constrained by the limited number of treatment/disposal processes that are implementable and proven effective for TCDD waste. Table 4-1 lists area-specific potential remedial actions, along with the maximum TCDD levels detected in the most recent sampling event, the TCDD action levels established for the site, and the reason for concern. The potential remedial actions identified for a given area represent a range in protectiveness.

A range of remedial action alternatives was assembled for the site as a whole using the area-specific potential remedial actions listed in Table 4-1. The six remedial action alternatives assembled represent a stepwise increase in the extent of remediation. The assembled alternatives are briefly outlined below and in Figure 4-1. Afterwards, each alternative is described in detail.

Alternative 1

- No further action would be taken to prevent human exposure to contaminated materials, to prevent contaminant migration, or to protect the environment. However, the current institutional controls would continue.

Table 4-1
Identification of Potential Remedial Actions (sheet 1 of 2)

Area	Maximum TCDD Concentration (ppb)/Year	TCDD Action Level (ppb)[a]	Concern	Potential Remedial Action
Collection Lines	>200/1984 (existing line)	1.0	Migration, Exposure (overflows)	No Action Remove Sediments and Incinerate Install Pipe Liners (Active Lines) Grout (Abandoned Lines) Remove Lines
Old STP				
Sludge Digester	12.5/1984	5.0	Exposure	No Action Restrict Access and Use Remove Sludge and Consolidate Remove Sludge and Incinerate
Sludge Drying Beds	2.8/1988	5.0	Exposure (gardening)	No Action Restrict Access and Use and Cap Remove and Consolidate Remove and Incinerate
Primary Clarifiers	1.6/1984	5.0	Exposure	No Action Restrict Access and Use Remove Sediment and Incinerate Demolish, Consolidate, and Cap
Trickling Filters	Not Sampled	5.0	Exposure	No Action Demolish, Consolidate, and Cap Restrict Access and Use
Secondary Clarifiers	Not Sampled	5.0	Exposure	No Action Demolish, Consolidate, and Cap Restrict Access and Use

Table 4-1
Identification of Potential Remedial Actions (sheet 2 of 2)

Area	Maximum TCDD Concentration (ppb)/Year	TCDD Action Level (ppb)[a]	Concern	Potential Remedial Action
West WWTP				
Aeration Basin	2.8/1988	5.0	Migration Exposure	No Action Restrict Access and Use Flood Protect Dewater and Cap Remove Sediments and Incinerate
Oxidation Ponds	0.97/1988	5.0	Migration	No Action Restrict Access and Use Flood Protect Dewater and Cap
Rocky Branch Creek and Bayou Meto Flood Plain				
Developed Residential Areas	1.135/1988	1.0	Exposure (contact, ingestion)	No Action
Undeveloped Residential Areas	9.7/1988	5.0		Restrict Access and Use Remove Soil and Incinerate
Nonresidential/Nonagricultural Areas	1.03/1987	5.0		Remove Soil and Consolidate
Rocky Branch Creek and Bayou Meto Sediments				
	2.3/1989	2.3[b]	Exposure (contact, ingestion)	No Action Advisory Against Fish Ingestion Continue Fish and Wood Duck Monitoring

[a]Based on ATSDR recommend actions (see Appendix B).
[b]Based on EPA memorandum to ATSDR (see Appendix A).

Alternative 2

- Collection Lines--Sediments would be removed from the active sewage collection lines between the Vertac Plant site and the West WWTP. This sediment would be incinerated onsite. No action would be taken on the abandoned collection lines.

- Old STP--The sludge would be removed from the sludge digester and consolidated onsite (on the Vertac Plant site) and capped. No action would be taken on other old STP treatment units. Access and use of the Old STP grounds would be restricted.

- West WWTP--Public access and use of the West WWTP grounds and facilities would be restricted.

- Rocky Branch Creek and Bayou Meto Flood Plain--In nonresidential, nonagricultural, and undeveloped residential areas with TCDD levels between 1.0 and 5.0 ppb, access and use would be restricted; in those areas with TCDD greater than 5.0 ppb, soils would be removed, consolidated onsite, and capped.

- Rocky Branch Creek and Bayou Meto Sediments--No action. Continue advisory against ingestion of fish and continue fish and wood duck monitoring.

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AREA	SUB-AREA OR VOLUME	REMEDIAL TECHNOLOGY	ALTERNATIVE 1	2	3	4	5	6a	6b
Collection lines	Active sewer lines	No action	●						
		Hydraulically clean		●	●	●		●	●
		Install pipe liners			●	●		●	●
		Remove and incinerate/construct new sewer lines					●		
	Abandoned Rocky Branch Interceptor	No action	●	●	●				
		Grouting						●	●
		Remove and incinerate				●	●		
Old STP	Grounds	No action	●						
		Restrict access and use		●	●	●	●	●	●
	Sludge digester	No action	●						
		Remove sludge and consolidate onsite		●					
		Remove sludge and incinerate			●	●	●	●	●
	Sludge drying beds	No action	●						
		Restrict access and use		●					
		Cover with asphalt cap			●				
		Cover with foot of soil						●	●
		Remove soil and incinerate				●	●		
	Primary clarifiers	No action	●	●	●	●			
		Remove sediment and incinerate					●		
		Treat water/demolish & cover with soil						●	●
	Secondary clarifiers and trickling filters	No action	●	●	●	●	●		
		Treat water/demolish & cover with soil						●	●
West WWTP	Aeration basin	No action	●						
		Restrict access and use		●	●	●	●	●	●
		Dewater and cap				●		●	●
		Remove sediment and incinerate					●		
	Oxidation ponds	No action	●						
		Restrict access and use		●	●	●	●	●	●
		Flood protect			●	●			
		Dewater and cap					●		
Rocky Branch Creek and Bayou Meto flood plain	Undeveloped residential soil with TCDD > 5.0 ppb	No action	●						
		Remove and consolidate		●					●
		Remove and incinerate			●	●	●	●	
	Undeveloped residential soil with 1.0 ppb < TCDD < 5.0 ppb	No action	●						
		Restrict access and use		●	●				
		Remove and incinerate				●	●	●	
		Remove and consolidate							●
Rocky Branch Creek and Bayou Meto sediments		No action	●	●	●	●	●	●	●
		Maintain advisory	●	●	●	●	●	●	●
		Fish and wildlife monitoring	●	●	●	●	●	●	●

FIGURE 4-1

ASSEMBLED REMEDIAL ACTION ALTERNATIVES

Vertac Off-Site FS, Jacksonville, Arkansas

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Alternative 3

- Collection Lines--Sediments would be removed from the active sewage collection lines between the Vertac Plant site and the West WWTP. This sediment would be incinerated. No action would be taken on the abandoned collection lines.

- Old STP--The sludge would be removed from the sludge digester and incinerated. The sludge drying beds would be paved with an asphalt cap. No action would be taken on other STP treatment units. Access and use of other areas of the Old STP grounds would be restricted.

- West WWTP--The oxidation ponds would be flood protected, by berming, against inundation during the 100-year flood. Access and use of the West WWTP facilities would be restricted.

- Rocky Branch Creek and Bayou Meto Flood Plain--In nonresidential, nonagricultural, and undeveloped residential areas with TCDD levels between 1.0 and 5.0 ppb, access and use would be restricted; in those areas with TCDD greater than 5.0 ppb, soils would be removed and incinerated onsite.

- Rocky Branch Creek and Bayou Meto Sediments--No action. Continue advisory against ingestion of fish and continue fish and wood duck monitoring.

Alternative 4

- Collection Lines--Sediments would be removed from the active sewage collection lines between the Vertac Plant site and the West WWTP and

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incinerated. Pipe liners would be installed in the cleaned sewer lines. The abandoned Rocky Branch Creek interceptor would be removed and incinerated onsite.

- Old STP--The sludge would be removed from the sludge digester and incinerated. Likewise, the sludge drying beds would be excavated and the material incinerated. No action would be taken on other STP treatment units. Access and use of the Old STP grounds would be restricted.

- West WWTP--The aeration basin would be dewatered, allowed to dry, and covered with a soil/vegetation cap. The oxidation ponds would be flood protected by berming against inundation during the 100-year flood. Access and use of the West WWTP grounds would be restricted.

- Rocky Branch Creek and Bayou Meto Flood Plain--Soil with TCDD levels greater than 1.0 ppb would be removed from all residential areas (developed or undeveloped). This soil would be incinerated.

- Rocky Branch Creek and Bayou Meto Sediments--No action. Continue advisory against ingestion of fish and continue fish and wood duck monitoring.

Alternative 5

- Collection Lines--The sewage collection lines (active and abandoned) running between the Vertac Plant site and the West WWTP and the soil surrounding the lines would be removed and incinerated. New sewer lines would be constructed.

- Old STP--The sludge would be removed from the sludge digester and incinerated. The sludge drying beds would be excavated and incinerated. The material would be removed from the primary clarifiers; the water would be treated and the sediment would be incinerated. No action would be taken on the trickling filters and secondary clarifiers. Access and use of the Old STP grounds would be restricted.

- West WWTP--The aeration basin sediments would be removed and incinerated. The oxidation ponds would be dewatered, allowed to dry, and covered with a soil/vegetation cap. The water removed from the aeration basin and oxidation ponds would be treated by sedimentation and carbon adsorption. Access and use of the West WWTP grounds would be restricted.

- Rocky Branch Creek and Bayou Meto Flood Plain--Soil with TCDD levels greater than 1.0 ppb would be removed. This soil would be incinerated.

- Rocky Branch Creek and Bayou Meto Sediments--No action. Continue advisory against ingestion of fish and continue fish and wood duck monitoring.

Alternatives 6a and 6b

- Collection Lines--Sediments would be removed from the active sewage collection lines between the Vertac plant site and the West WWTP and incinerated. Pipe liners would be installed in the cleaned sewer lines. Abandoned line would be filled with grout.

- Old STP--The sludge would be removed from the sludge digester and incinerated. The sludge drying beds would be covered with 1 foot of clean soil. Accumulated water in treatment units would be removed and treated. The treatment units would be demolished and covered with 1 foot of clean soil. A notice restricting access and development would be placed in the deed.

- West WWTP--The aeration basin would be dewatered, the dikes demolished, and the entire basin covered with 1 foot of clean soil. A notice restricting access and use would be placed in the deed.

- Rocky Branch Creek and Bayou Meto Flood Plain--Soil with TCDD levels greater than 1.0 ppb would be removed from all areas and either incinerated (6a) or consolidated onsite (6b).

- Rocky Branch Creek and Bayou Meto Stream Sediments--No action, continued ban on fishing, and fish and wildlife monitoring.

DESCRIPTION OF ALTERNATIVES

The following subsections present a detailed description of the six remedial alternatives for the Vertac off-site areas. Each alternative, with the exception of Alternative 1, combines remedial action components for each area to produce a sitewide remedial action alternative. Flow diagrams of remedial action Alternatives 2 through 6 accompany the descriptions that follow. Alternative 1 is the no-action alternative, as required by the NCP, and therefore no flow diagram is presented.

ALTERNATIVE 1

The no-action alternative consists of taking no further action to prevent human exposure to contaminated materials, prevent migration of contaminants, or protect the environment. However, the currently existing conditions, institutional controls, and studies would continue. These include:

- The fences that restrict access from the developed residential area to contaminated sections of Rocky Branch Creek.
- The access and use restrictions at the undeveloped residential area along the east side of the west leg of Rocky Branch Creek owned by Hercules Inc. This land is fenced and has signs to restrict access.
- The access and use restrictions at the Old STP and West WWTP. These facilities are only partially fenced.

ALTERNATIVE 2

Figure 4-2 is a flow diagram of Alternative 2.

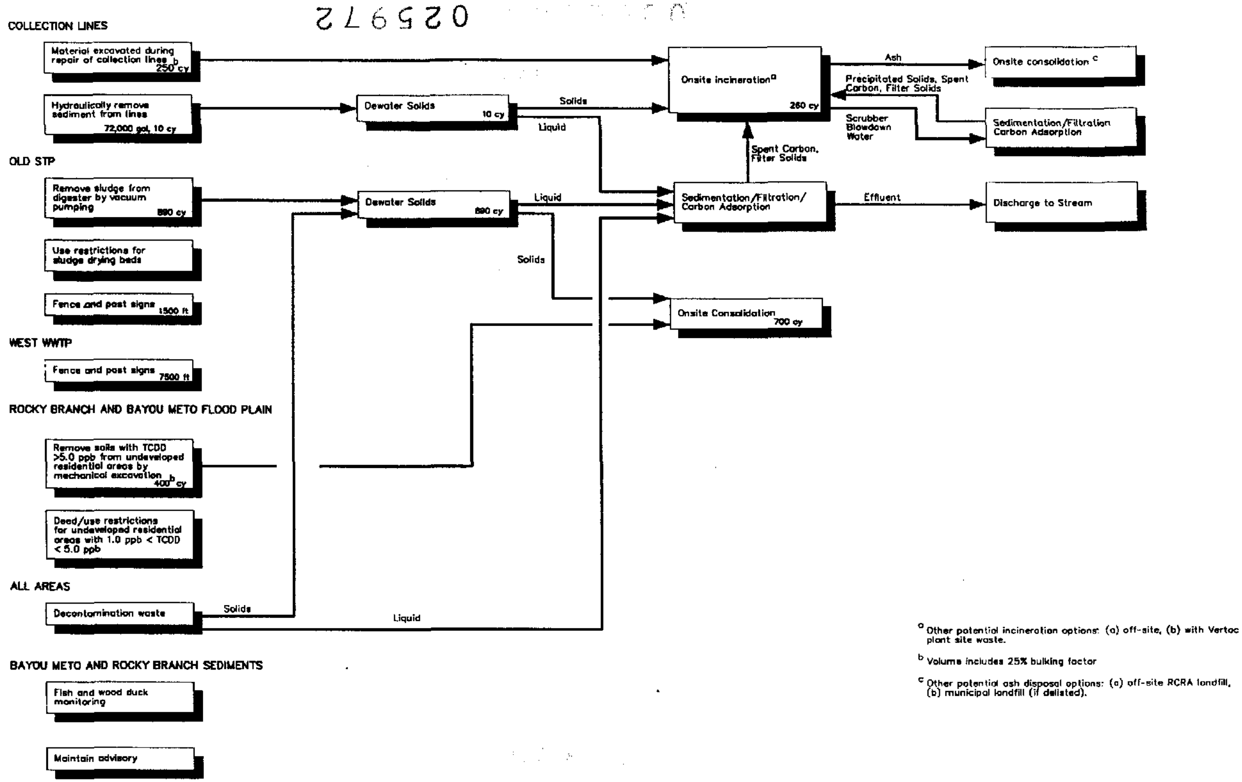
Alternative 2--Collection Lines

The sewer collection lines under consideration in this FS include two interceptor lines running parallel to Rocky Branch Creek (Figure 2-4 in Section 2). The westernmost Rocky Branch Creek interceptor was abandoned in 1978 when the eastern most interceptor was constructed. In this alternative, only the active sewer lines would be cleaned; the abandoned interceptor would be left in place. The collection lines to be cleaned include the trunk line running diagonally through the residential area from the Vertac Plant site and the active Rocky Branch Creek interceptor.

Damaged manholes along the active sewer lines would be repaired or, if necessary, replaced. The 1985 RI evaluation of manhole structural integrity found that most of the defects occurred on the Vertac Plant site and along the abandoned Rocky Branch Creek interceptor, neither of which are part of the active sewage collection system. (Lines serving the Vertac Plant site would be disconnected before the off-site collection lines are cleaned.) The 1985 RI findings indicate that defects in manholes along the active lines are minor and could be repaired using an epoxy grout lining. Other possible rehabilitation measures include preformed polyethylene liners, formed-in-place resin liners, or manhole replacement. It is assumed that grouting would be sufficient to rehabilitate most of the manholes but a more extensive restoration method would be employed if necessary.

The volume of sediment in the active collection lines is estimated to be 10 cubic yards (cy). This volume is based on the results of the 1985 RI sewer lamping study. It is assumed that upstream laterals and service lines tying into the sewers do not contain contaminated sediments and do not require remediation.

In this alternative, 10,350 feet of collection lines would be cleaned of contaminated sediments and debris by hydraulic flushing combined with vacuum pumping. The pipe-cleaning procedure is illustrated in Figure 4-3. An obstruction is placed in the pipe immediately downstream from a manhole. A hose, fitted with a nozzle that directs flow backwards, is fed through the manhole into the upstream pipe. The hydraulic force of the water jet is allowed to carry the nozzle upstream to the adjacent manhole. The flushing hose is then slowly retrieved to hydraulically flush the entire length of pipe with a pressurized stream of water. The water and sediment are simultaneously pumped through a hose at the downstream manhole into a tank truck. The obstruction is then removed and the procedure repeated in downstream segments. Additional vacuuming would be employed as needed to remove sediments from manholes.



a Other potential incineration options: (a) off-site, (b) with Vertac plant site waste.

b Volume includes 25% bulking factor

c Other potential ash disposal options: (a) off-site RCRA landfill, (b) municipal landfill (if delisted).

FIGURE 4-2

ALTERNATIVE 2 FLOW DIAGRAM

Vertac Off-Site FS
Jacksonville, Arkansas

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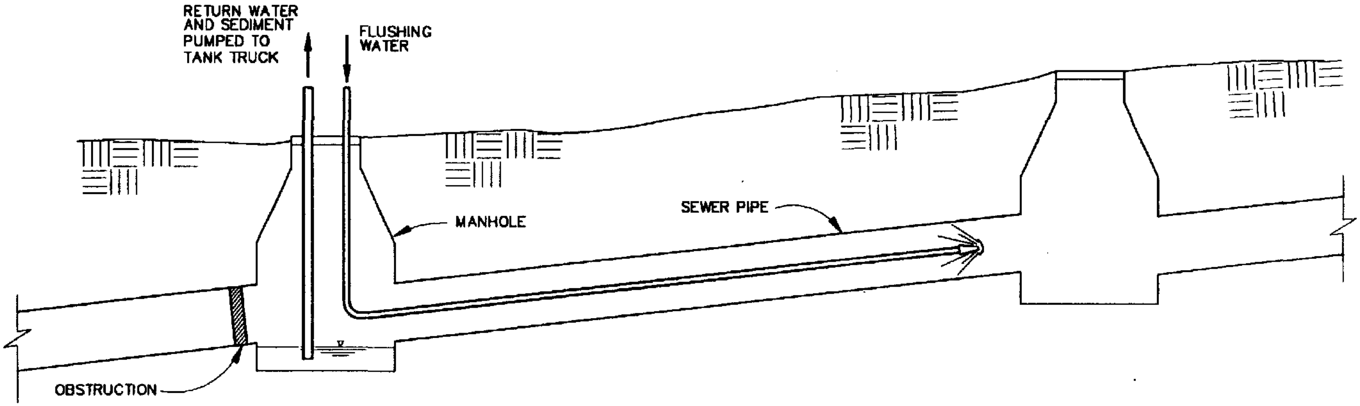

FIGURE 4-3

HYDRAULIC CLEANING PROCEDURE FOR SEWER LINE

Vertac Off-Site FS
Jacksonville, Arkansas

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Residents would be informed about the cleaning and appropriate safety procedures. The flushing water is continuously removed during cleaning; therefore, transport of contaminated sediments into laterals should be minimal. Nevertheless, the cleaning operation would be supervised constantly and devices installed, if necessary, to prevent the flow of water or vapors into laterals and service lines.

The RI reported that the primary obstructions in the sewer lines were grease, roots, dirt, and gravel. Bricks and concrete from manholes have also fallen into sewer lines. The lines to be cleaned would be inspected with video cameras to locate obstructions. Some sections (5 percent of the total active pipe length is assumed) may require supplemental mechanical cleaning to remove major obstructions.

It is likely that damaged sections of pipeline would have to be repaired to allow hydraulic cleaning. Based on the lamping study conducted during the RI, it is assumed that 3 percent of the sewer lines, excluding the abandoned Rocky Branch Creek interceptor, would require repair. At least 1 foot of soil surrounding damaged pipe and (250 cy) would be excavated during repair and incinerated because of the likelihood of TCDD contamination.

The poor structural characteristics of the 4,350-foot abandoned Rocky Branch Creek interceptor, described in the 1985 RI, indicate that it cannot be hydraulically cleaned. It is plugged with concrete at both ends and there are no known interconnections, including exfiltration/infiltration, between the abandoned and active Rocky Branch Creek interceptors. As long as the abandoned interceptor remains undisturbed in the ground, there is no direct route for human exposure. Therefore, in this alternative, the abandoned Rocky Branch Creek interceptor would be left in place.

There are two main advantages of hydraulic cleaning: essentially all the sediment can be flushed to manholes and removed from the sewers, and there is little or no disruption of service. During the hydraulic cleaning, sanitary flow would be pumped to adjacent manholes.

Hydraulic flushing generates large quantities of water (estimated at 7 gallons per foot of sewer). Further contamination of the aeration basin would be prevented by collecting the flushing water as each segment is cleaned. This water would be treated by sedimentation, filtration, and carbon adsorption (see "Wastewater Treatment" later in this section).

Sediments can be effectively removed from the water by sedimentation and dewatering (see "Solids Dewatering" later in this section). It is assumed that the 10 cy of sediment separated from the bulk liquid would contain 20 percent solids. This material would be dewatered to 6.7 cy at 30 percent solids. Because the sediments in the collection lines have been found to contain TCDD concentrations in excess of 200 ppb (1984 data), the dewatered solids would be incinerated.

Inspection of the sewers after cleaning would involve:

- Television inspection to determine the adequacy of the cleaning and required repairs and to detect any unauthorized connections

- Smoke testing to identify points of infiltration/ exfiltration and unauthorized inflow

If television inspection indicated remaining obstructions, additional cleaning (probably mechanical followed by hydraulic flushing) would be required. It is assumed that the inspection would indicate that no additional cleaning and repair would be required.

After completion of sewer cleaning, the equipment involved (trucks, hoses, pumps) would be decontaminated. Decontamination procedures would include hydrocleaning, with water from the procedure captured for treatment. When the decontamination procedure is completed, the equipment would be wipe-tested and the wipe cloths analyzed for TCDD to assure that no contamination remained on the equipment. The equipment would be impounded until the test results indicated decontamination was complete.

Alternative 2--Old STP

Sludge would be removed from the sludge digester using a vacuum pumping system. The estimated 890 cy of digested biological sludge assumed to be 5 percent solids would be dewatered (as described under "Solids Dewatering" later in this section) to approximately 300 cy at 15 percent solids. The dewatered sludge would be consolidated on the Vertac Plant site and capped. This and other consolidated material would be covered with a multilayered cap consistent with RCRA requirements. Onsite consolidation and capping of waste materials is described in more detail under "Alternative 2--Rocky Branch Creek and Bayou Meto Flood Plain" later in this section.

The empty sludge digester would be cleaned with a hot, pressurized, biodegradable cleaning mixture. All other equipment would be decontaminated by hydrocleaning. The leachate from sludge dewatering and the used washing and decontamination solutions would be treated by sedimentation/filtration and carbon adsorption (see "Wastewater Treatment" later in this section).

No action would be taken on the remaining treatment units. The grounds of the Old STP would be fenced (1,500 linear feet) and signs posted every 100 feet to restrict access to contaminated areas of the plant. Particular emphasis should be put on preventing the use of the sludge drying beds for gardening. A TCDD concentration of 2.8 ppb was measured in a composite soil sample from the sludge drying beds in 1988, so human exposure to this area should be minimized.

Alternative 2--West WWTP

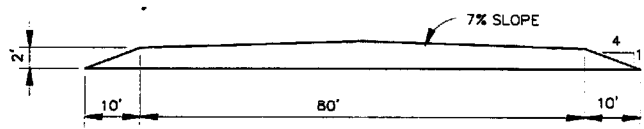
The oxidation ponds and aeration basin would be fenced (7,500 linear feet) and signs posted to restrict access to those facilities.

Alternative 2--Rocky Branch Creek and Bayou Meto Flood Plain

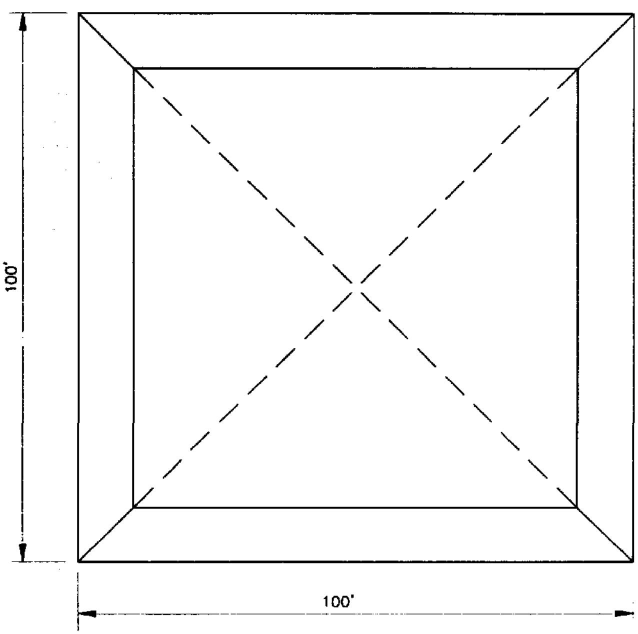
In developed residential areas, all soils with greater than 1.0 ppb of TCDD have been excavated and are temporarily stored in plastic bags on the Vertac Plant site. The 1,623 bags contain 2,400 cubic yards of soil, including: a) soil from the residential areas immediately east of the west leg of Rocky Branch Creek, b) soil from the residential area just south of the Vertac property line and west of the east leg of Rocky Branch Creek, and c) soil from a drainage area on the Vertac Plant site just north of the Vertac property line and adjacent to (b) (see Figure 2-10 in Section 2). These stored soils will be addressed as part of the onsite FS.

Soils from undeveloped residential areas with TCDD levels greater than 5.0 ppb would be removed with backhoes to a depth of 1 foot. This category includes two sampling grids--Numbers 17 and 18 from EPA's 1988 sampling effort--just west of the west leg of Rocky Branch Creek and just south of the Vertac property line, and would result in 400 cubic yards of soil (assuming a 25 percent bulking factor). This soil would be consolidated on the Vertac Plant site and capped as part of Alternative 2.

The total of 700 cy of material to be consolidated in Alternative 2 includes 300 cy of dewatered sludge from the digester and 400 cy of soil excavated under this alternative. Since this material consists largely of contaminated native soil, it is assumed that it would be compactable and that compaction would reduce the volume of soil by 25 percent. For consolidation, the material would be placed on the plant site and compacted into a mound with a shape and size resembling that shown in Figure 4-4.



CROSS SECTION



PLAN VIEW

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FIGURE 4-4

REPRESENTATIVE CONFIGURATION OF CONSOLIDATED MATERIAL

Vertac Off-Site FS
Jacksonville, Arkansas

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A multilayer cap composed of the layers shown in Figure 4-5 would then be placed over the contaminated material, assuming the same slopes as the consolidated material (Figure 4-4). The cap would be consistent with federal and state RCRA requirements for landfill closures. The overall surface area required for consolidation would be roughly 0.3 acre. The native materials required for construction of the cap would be 162 cy of topsoil and sand; 475 cy of native soil; and 650 cy of clay. Based on soil type descriptions in the Jacksonville area, it is expected that materials suitable for cap construction are available locally.

When placed in an area restricted from public access and further isolated by capping, the consolidated material should be reasonably secure with respect to human health, contaminant migration, and environmental protection concerns. The excavated area would be backfilled with clean soil and seeded with grass.

Residentially zoned but currently undeveloped areas in the off-site study area include land west of the west leg of Rocky Branch Creek, land between the two legs of Rocky Branch Creek near their confluence, and land southwest of the West WWTP (see Figure 2-17 in Section 2). Soils in two of these areas contain TCDD levels between 1.0 and 5.0 ppb. One of these areas includes much of the privately owned land west of the west leg of Rocky Branch Creek (0.81 acres of land, including 1988 EPA sampling grid Numbers 9, 10, 11, 13, 14, 15, and 16). The other area is 1.03 acres of land east of the west leg of Rocky Branch Creek just north of the confluence of the east and west legs (see Figure 2-10 in Section 2). The latter area was purchased by Hercules Inc. and fenced with a 6-foot cyclone fence topped with three strands of barbed wire to restrict access and residential development. In this alternative, the zoning of both the contaminated privately owned property west of the west leg of Rocky Branch Creek and the Hercules property would be changed to a nonresidential/nonagricultural classification.

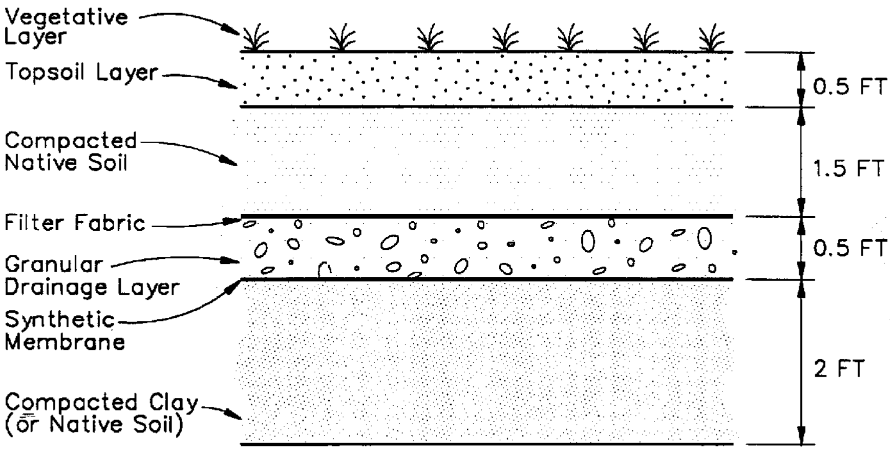

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FIGURE 4-5

MULTILAYERED RCRA CAP

Vertact Off-Site FS
Jacksonville, Arkansas

J: \INDUST\DEN69071\FIG-2.DWG

Alternative 2--Rocky Branch Creek and Bayou Meto Sediments

The remedy for Rocky Branch Creek and Bayou Meto sediments is based on the recommendations contained in the 1989 memorandum from EPA to ATSDR (see Appendix A). These recommendations include a continued advisory against ingestion of fish taken from Rocky Branch Creek and Bayou Meto. The memorandum states that the levels of TCDD found in the sediments should not pose an unacceptable human health threat if this advisory is continued and is effective. This remedy also includes continued monitoring of fish and wildlife.

ALTERNATIVE 3

Figure 4-6 is a flow diagram of Alternative 3.

Alternative 3--Collection Lines

The collection lines would be cleaned by hydraulic flushing as described in Alternative 2. Only the active lines would be cleaned; the abandoned Rocky Branch Creek interceptor would be left in place. Sediments removed from the sewer lines would be dewatered and the solids incinerated. The flushing water and the water from the solids dewatering would be treated by the wastewater treatment system.

Damaged manholes along the active sewer lines would be repaired as described in Alternative 2.

The hydraulically cleaned collection lines would be lined with a resin-type lining system. One such system employs a liquid thermosetting resin that is hardened in place to conform to the interior contours of the existing pipe. Installation of this type of pipe liner is illustrated in Figure 4-7. A resin-impregnated felt "sock" is fed into the pipe and filled with water to press the resin-coated side firmly against the pipe walls. Hot water is circulated to cure the resin. The sock is then removed, the resin pipe ends cut off, and the lateral connections reopened using a remote-controlled cutting device.

Rehabilitating the manholes and sewer lines would greatly reduce the probability of contaminant migration to the new WWTP. Soil surrounding the sewer lines may have been contaminated by exfiltration over the 40+ years that waste was conveyed from the Vertac Plant site. The liners would virtually eliminate infiltration of contaminated soil and water. Also, the resin-type liners can be made thick enough to provide structural integrity.

The main sewer line running through the residential area south of the Vertac Plant site consists of clay pipe installed in 1941. This pipe is approaching the end of its service life, and would soon require replacement if not rehabilitated. Excavation of this line in the future could constitute a hazard due to exposure to TCDD-contaminated soil. Rehabilitation of the active sewer lines with resin-type liners should provide sufficient structural integrity to preclude the need to replace those lines in the near future.

Alternative 3--Old STP

The sludge digester would be emptied and cleaned as in Alternative 2; however, in this alternative the 300 cubic yards of dewatered biological sludge from the digester would be incinerated rather than consolidated onsite. The digester sludge had a maximum TCDD concentration of 12.4 ppb in 1984. Incineration would destroy this contamination, as opposed to consolidating it as in Alternative 2.

The sludge drying beds and surrounding soils would be capped with asphalt. The area that would be capped is the 120-foot-by-267-foot Section E-1 delineated in the 1988 Hercules sampling study (Hercules Inc., 1988). That study found TCDD levels of

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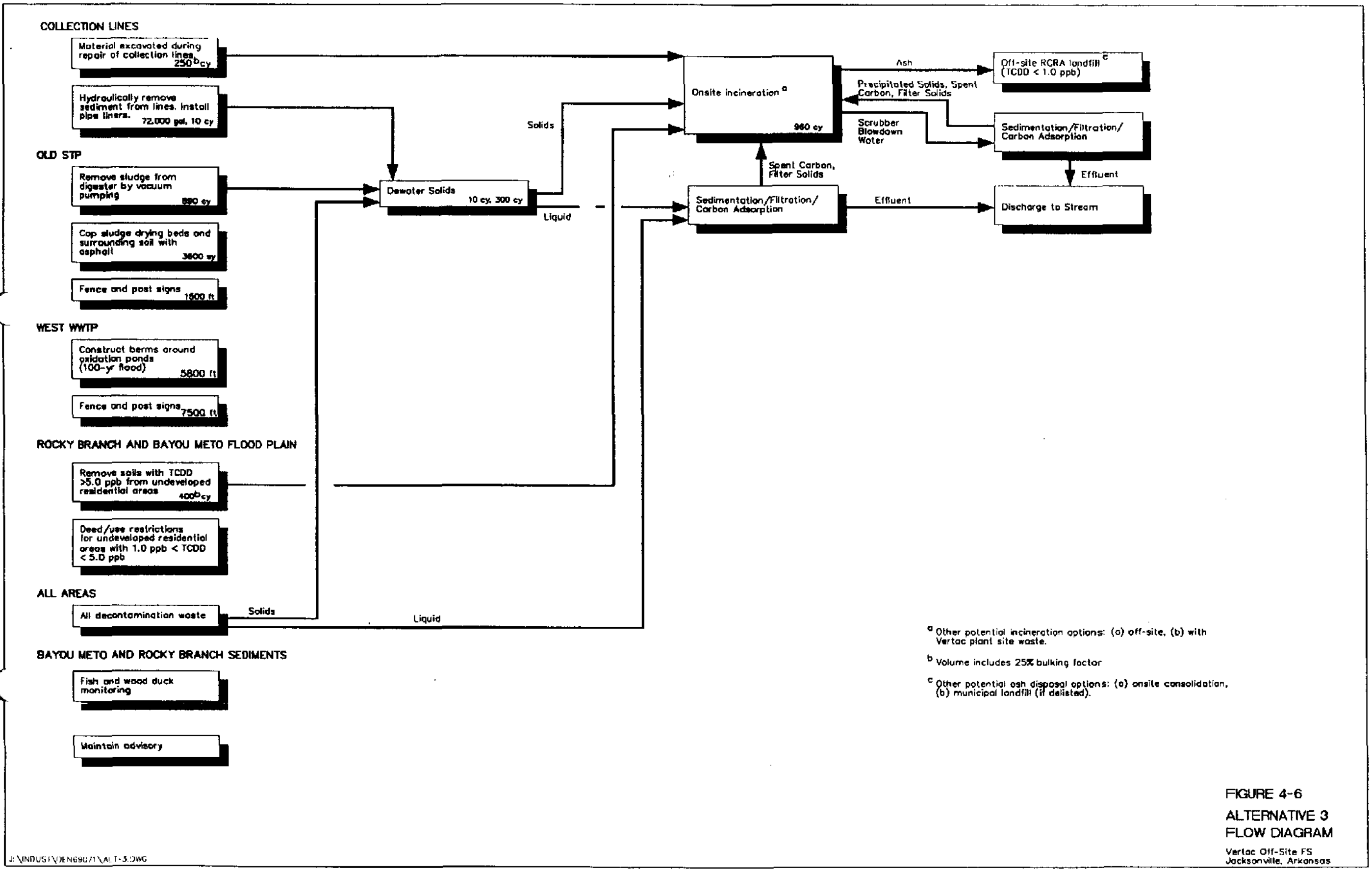

FIGURE 4-6
ALTERNATIVE 3
FLOW DIAGRAM

Vertac Off-Site FS
Jacksonville, Arkansas

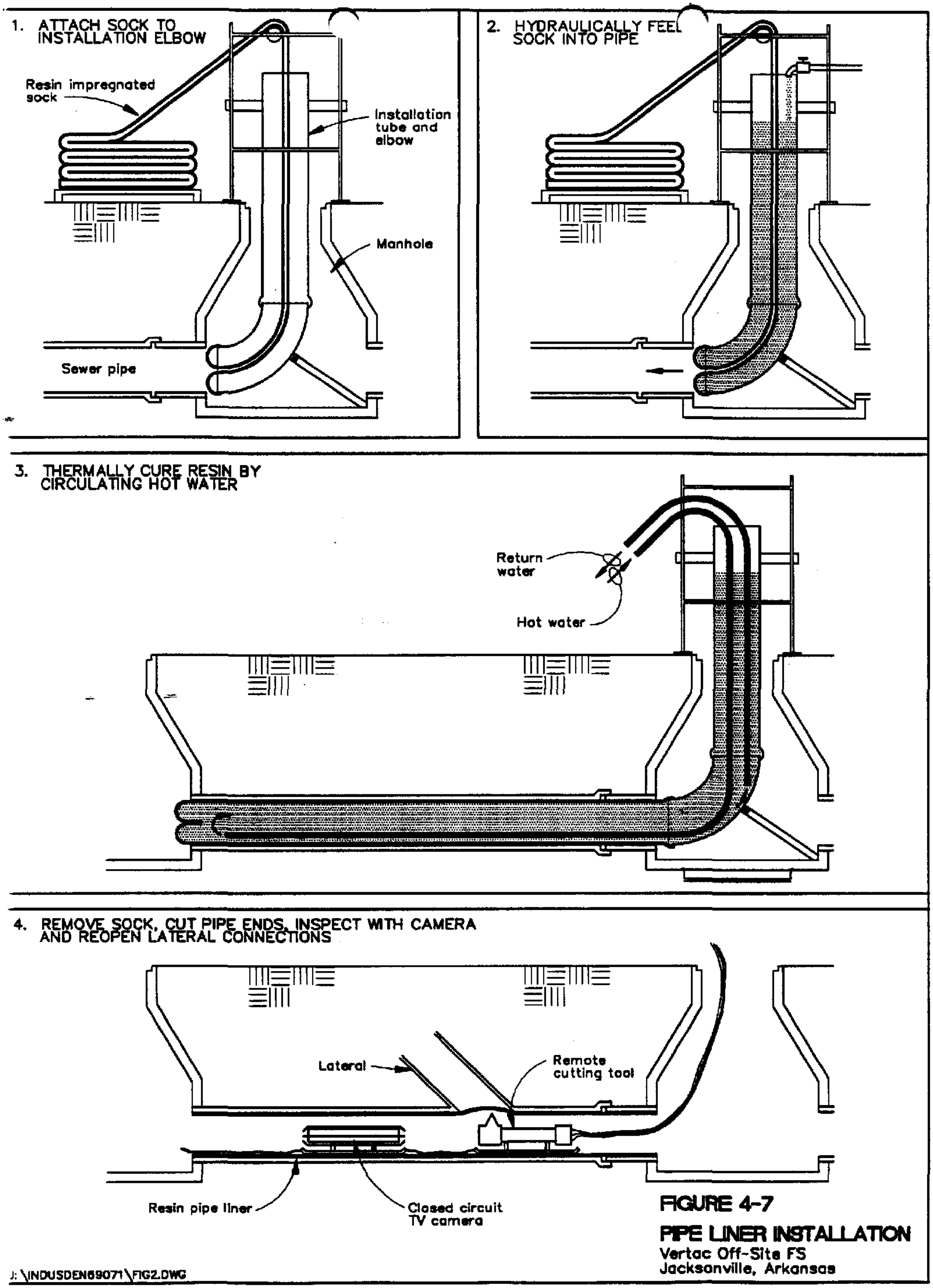

FIGURE 4-7

PIPE LINER INSTALLATION

Vertac Off-Site FS
Jacksonville, Arkansas

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2.30 and 1.01 ppb in composite samples of the drying beds and surrounding soils, respectively (see Figure 2-12 in Section 2). Although these concentrations are less than the 5.0 ppb action level for TCDD in nonresidential and nonagricultural areas, the sludge beds have been used for vegetable and flower gardening in the past. Paving this area with a hard asphalt cap would prevent gardening and direct human contact in the future.

The area to be paved would be prepared by demolishing the concrete curbs surrounding the sludge-drying beds and then grading. A small bulldozer and, if necessary, a light grader would be employed for these tasks. A geotextile would be rolled over the prepared subgrade. A layer of 4 to 6 inches of crushed gravel would be spread over the geotextile and compacted. The compacted gravel base would be covered with a 2-inch layer of dense graded asphalt-concrete pavement. The pavement mixture would be designed with a high asphalt content to retard oxidation and subsequent thermal cracking. All equipment used to move or grade contaminated soil would be decontaminated.

No action would be taken at the other STP units. Fencing and posting signs would further deter access to or use of the Old STP grounds.

Alternative 3--West WWTP

The highest TCDD concentrations found in the 1988 grid sampling of the West WWTP facilities were 2.8 ppb in the aeration basin and 0.97 ppb in the oxidation ponds. Both of these values are below the ATSDR/EPA site-specific action level of 5.0 ppb for nonresidential and nonagricultural areas, and there is no known direct human use of these areas. The West WWTP facilities (oxidation ponds and aeration basin) would be fenced and signs posted to restrict public access and use in Alternative 3.

The primary concern for the West WWTP is that sludge and sediment from the bottom of the oxidation ponds may be scoured during a flood event and transported to relatively uncontaminated areas. Information from the USGS indicates that the 100-year flood elevation in this area is 250.8 feet above mean sea level (msl). The walls of the aeration basin are higher than 253 feet above msl, placing that facility out of the 100-year flood plain. However, the oxidation ponds, with walls approximately 246 feet above msl, are in the 5-year flood plain. In this alternative, the oxidation ponds would be protected against inundation during a 100-year flood by constructing earthen dams around their perimeter (5,800 ft).

The berms would be constructed using a low permeability soil such as the local silts and clays. The berm design would feature 3:1 side slopes, a 15-foot top width, 252.8 foot elevation (above msl), vegetative cover except for crushed gravel road surface, and exterior perimeter drainage ditch (Figure 4-8). Roughly 141,800 cy of material would be required to construct berms around the oxidation ponds (this number assumes an average ground surface elevation of 242 feet above msl and is an overestimate because it was not reduced by the volume of material in the existing berms, which would be incorporated into the new ones).

Once the sewage collection lines are connected to the new WWTP, the inlet to the aeration basin would be blocked off. The only remaining flow into the aeration basin and oxidation ponds would be precipitation. Since the precipitation rate exceeds the evaporation rate in Arkansas, water could potentially accumulate in the aeration basin and oxidation ponds. This water would be allowed to flow from the aeration basin to the oxidation ponds and to Bayou Meto. Because of the hydrophobic nature of TCDD, it should strongly associate with the organic material in the basin sediments. Outlets from the basins would be constructed to prevent entrainment of sediments.

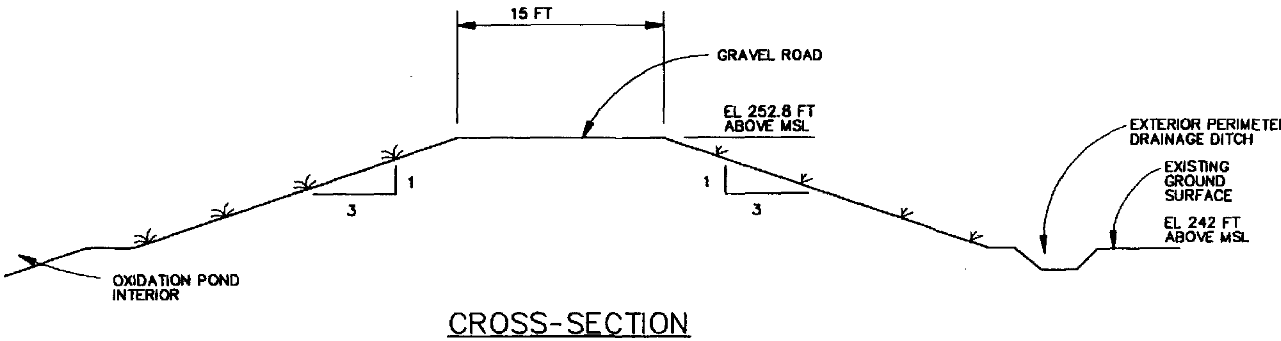

FIGURE 4-8
EARTHEN FLOOD-CONTROL BERM CONFIGURATION

Vertac Off-Site FS
Jacksonville, Arkansas

J:\INDUST\DEN69071\FIG4-8.DWG

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Alternative 3--Rocky Branch Creek and Bayou Meto Flood Plain

As in Alternative 2, soil would be excavated from 1988 EPA grid-sampling Sections 17and 18, and those areas would be backfilled and seeded. This soil would be incinerated (see "Incineration" later in this section). In this alternative, all wastes with TCDD levels above 5.0 ppb would be incinerated, including 400 cubic yards of currently in-place soil; 300 cubic yards of dewatered digester sludge, and 10 cubic yards of collection line sediment.

As in Alternative 2, zoning changes would be sought for undeveloped residential areas with soil TCDD levels between 1.0 and 5.0 ppb. A zoning change to nonresidential/ nonagricultural would help prevent long-term direct human contact with contamination in those areas.

Alternative 3--Rocky Branch Creek and Bayou Meto Sediments

The remedy for this area is identical to Alternative 2.

ALTERNATIVE 4

Figure 4-9 is a flow diagram of Alternative 4.

Alternative 4--Collection Lines

The active sewer lines would be cleaned by hydraulic flushing and the cleaned pipes would be lined, as described in Alternatives 2 and 3, respectively.

The abandoned Rocky Branch Creek interceptor (see Figure 2-13 in Section 2) contained TCDD levels as high as 70.5 ppb in 1984. As long as the abandoned interceptor remains undisturbed, there is no direct route for human exposure. However, if it is uncovered during excavation in the area (for example, while repairing the adjacent active interceptor), human exposure could occur. Hence, removal of this potential contaminant source represents a higher degree of protection than leaving the sewer lines in place.

In this alternative, mechanical trenching and excavation equipment, such as backhoes, would remove the 4,350-foot abandoned Rocky Branch Creek interceptor, contaminated sediments within the pipe, and a minimum of 2 feet of potentially contaminated soil surrounding the pipe (4 feet x 4 feet). These sediments and debris (approximately 3,200 cubic yards considering a 25 percent bulking factor) would be dewatered and incinerated (see "Solids Dewatering" and "Incineration" later in this section). The resulting trench would be backfilled with clean soil. All flushing and decontamination liquids would be treated by the onsite wastewater treatment system.

Alternative 4--Old STP

Backhoes would excavate to a depth of 1 foot the sludge drying beds and surrounding soil (Section E-1; Hercules Inc., 1988). Approximately 1,500 cubic yards of excavated material (assuming 25 percent bulking) would be incinerated. As in Alternative 3, the sludge would be pumped from the sludge digester, dewatered, and incinerated. No action would be taken at the other STP units. The Old STP grounds would be fenced and warning signs posted to restrict access.

Alternative 4--West WWTP

The 6.8 million gallons of water in the 3-acre aeration basin would be drained and pumped into the oxidation ponds and the aeration basin would be allowed to dry. After dewatering and drying, the aeration basin would be capped. The purpose of the

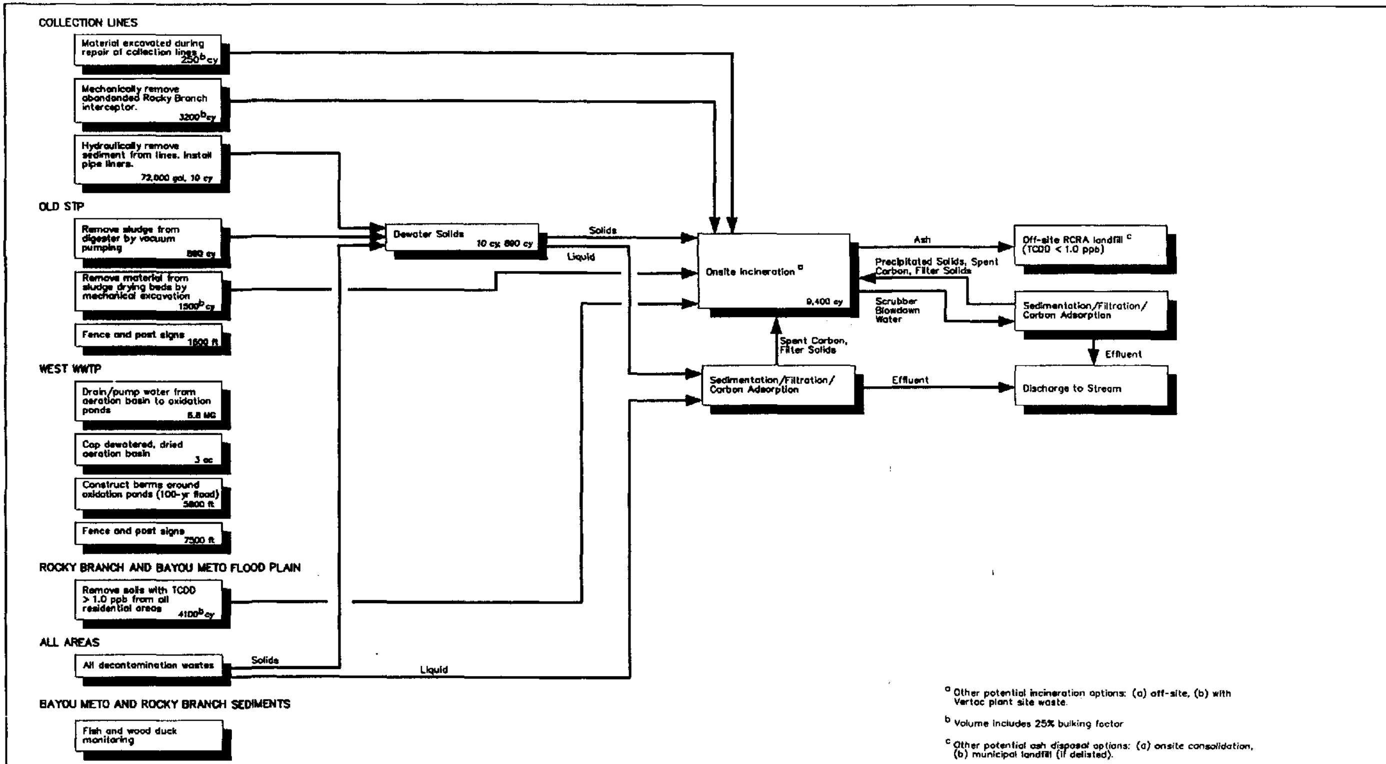

FIGURE 4-9
ALTERNATIVE 4
FLOW DIAGRAM
Vertac Off-Site FS
Jacksonville, Arkansas

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cap would be to provide a barrier against migration of contaminated sediments in the aeration basin. The basin would be filled with compacted native soil, 6 to 12 inches of topsoil, and a vegetative layer. The cap would be designed to grade naturally with the surrounding soil. Assuming an average depth of 10 feet in the aeration basin, the cap would require 46,000 cy of native soil and 2,400 cy of topsoil (compacted volumes).

As described in Alternative 3, berms would be constructed to protect the oxidation ponds against inundation during a 100-year flood. Water accumulating in the oxidation ponds from precipitation would be allowed to flow to Bayou Meto via an outfall designed to prevent sediment entrainment. Also, the West WWTP facilities would be fenced and warning signs posted.

Alternative 4--Rocky Branch Creek and Bayou Meto Flood Plain

Soil would be excavated to a depth of 1 foot from all residential areas (developed or undeveloped) with TCDD concentrations greater than 1.0 ppb. Areas to be excavated would include 1988 EPA Sampling Grid Numbers 9, 10, 11, 13, 14, 15, 16, 17, and 18 from the west side of the west leg of Rocky Branch Creek and the Hercules property on the east side of the west leg of Rocky Branch Creek near the confluence with the east leg. Removal of this soil would remove the risk associated with potential future development in areas zoned residential with TCDD concentrations greater than the 1.0-ppb action level for residential areas. These lands would be backfilled with clean soil and revegetated following excavation. The excavated soil (4,100 cubic yards, including a 25 percent bulking factor) would be incinerated.

Alternative 4--Rocky Branch Creek and Bayou Meto Sediments

Same as Alternatives 2 and 3.

ALTERNATIVE 5

Figure 4-10 is a flow diagram of Alternative 5.

Alternative 5--Collection Lines

In this alternative, all 14,700 feet of active and inactive sewer lines and all manholes would be mechanically removed, as would at least 2 feet of soil surrounding the pipes. The contaminated sediments and debris (approximately 10,900 cubic yards) would be dewatered. Solids would be incinerated, and liquids would be treated by the wastewater treatment system. Removal of the contaminated collection lines and installation of new lines would preclude contamination of the new WWTP.

Wastewater collection must continue during the removal of the contaminated sewer lines; therefore, a new sewerage system, running from the residential area south of the Vertac property to the new wastewater treatment plant, must be installed before excavating the existing lines. For this alternative as well as the others, the timing of various actions is critical for providing continuous wastewater collection and preventing contamination of the new wastewater treatment facility. Remedial actions that must be temporally coordinated include:

- Disconnection of sewer lines from the Vertac Plant site wastewater treatment system

- Cleaning, removal, and replacement of existing collection lines

- Connection of cleaned, new lines to the new WWTP

- Closeout of the West WWTP

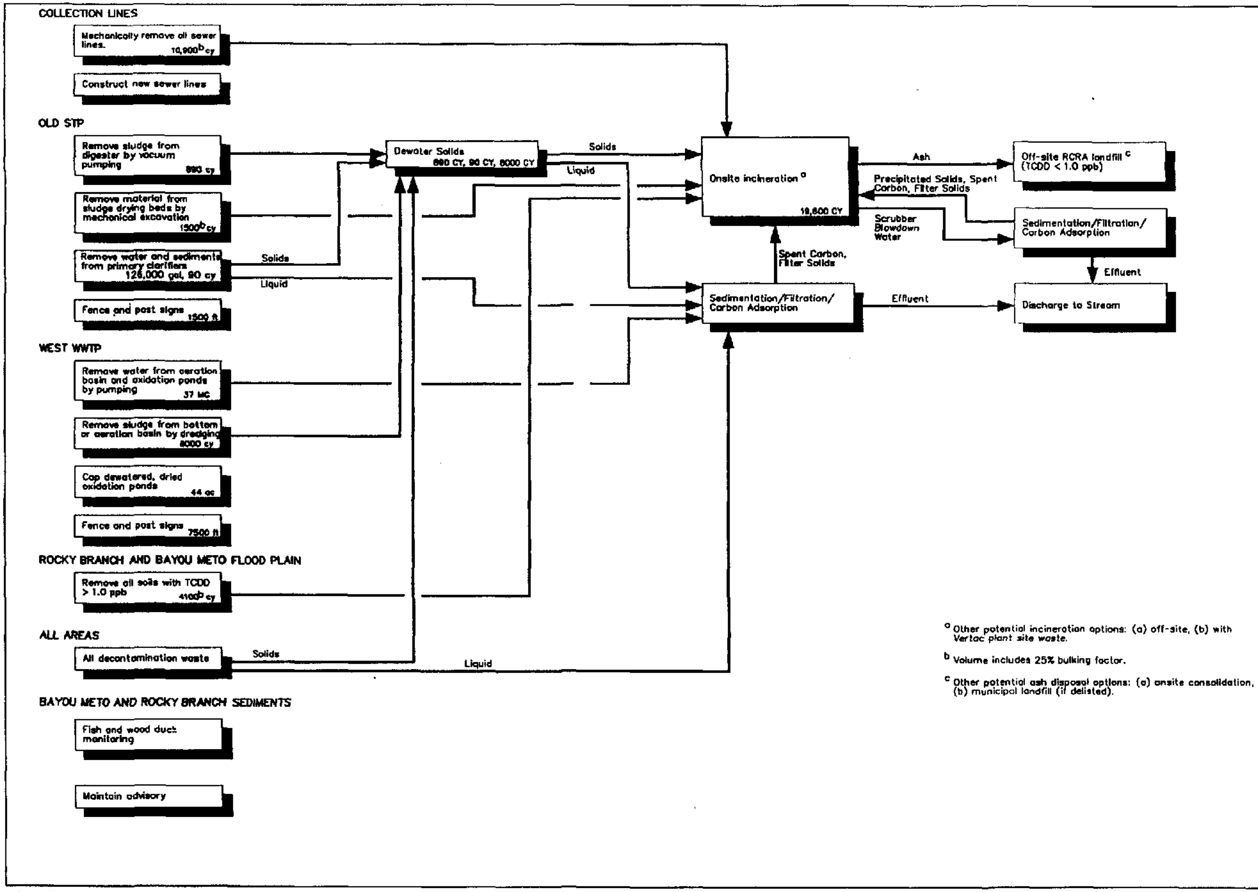

FIGURE 4-10

ALTERNATIVE 5 FLOW DIAGRAM

Vertac Off-Site FS
Jacksonville, Arkansas

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Alternative 5--Old STP

As in Alternative 4, the sludge digester would be emptied and cleaned and the sludgedrying beds excavated and backfilled. Material from both the digester and drying beds would be incinerated. Also, the Old STP grounds would be fenced and warning signs posted.

Other facilities that comprise the Old STP include two primary clarifiers, two trickling filters, and two secondary clarifiers. All are inactive. The primary clarifiers were sampled only in 1984; a grab sample of the east primary sediments had a dioxin concentration of 1.62 ppb and a grab sample of the west primary sediments contained 0.23 ppb of dioxin. The trickling filters and secondary clarifiers have not been sampled. The grounds of the Old STP in the vicinity of these facilities were grid sampled in 1988. The analyses indicated a level of 0.31 ppb for the area, which is lower than the lowest action level of 1.0 ppb. Based on the available data, this alternative recommends that the water and sediments be removed from the primary clarifiers. The water (126,000 gallons) would be treated by filtration and carbon adsorption and the sediments (90 cubic yards) dewatered and incinerated. No action would be taken on the two trickling filters and two secondary clarifiers.

Alternative 5--West WWTP

Roughly 8,000 cubic yards of contaminated sludge estimated to be on the bottom of the aeration basin would be removed, dewatered, and incinerated. The sludge would be removed from the bottom using a pontoon-mounted, floating pumping system. The 37 million gallons of water would be pumped from the aeration basin and oxidation ponds to the onsite wastewater treatment system (see "Wastewater Treatment" later in this section). After dewatering, the oxidation ponds would be allowed to dry and then covered with a soil/ vegetative cap. It is assumed that the bottom sediments would dry sufficiently to allow capping/compaction. The cap would consist of native compacted soil covered with 6 inches of topsoil and a vegetative layer, constructed so that its surface grades naturally with the surrounding soil. Assuming an average depth of 3 feet in the oxidation ponds, the cap will require 178,000 cy of native soil and 36,000 cy of topsoil (compacted volumes). Also, the outfall ditch from the oxidation ponds would be filled with clean native soil, and seeded. Fences and warning signs would be constructed around the West WWTP facilities.

Alternative 5--Rocky Branch Creek and Bayou Meto Flood Plain

Soils with TCDD concentrations greater than 1.0 ppb would be removed and incinerated as described in Alternative 4.

Alternative 5--Rocky Branch Creek and Bayou Meto Sediments

Same as Alternatives 2, 3, and 4.

ALTERNATIVES 6A AND 6B

Figure 4-11 is a flow diagram of Alternatives 6a and 6b.

Alternatives 6a and 6b--Collection Lines

The active sewer lines would be cleaned by hydraulic flushing as described in Alternative 2. Sediments removed from the active lines would be dewatered and incinerated onsite. Water from the collection lines would be treated through sedimentation, filtration, and carbon adsorption. Spent carbon and filter solids would be incinerated onsite and treated water would be discharged to Rocky Branch Creek. Pipeliners would be installed in the clean active line as described in Alternative 3.

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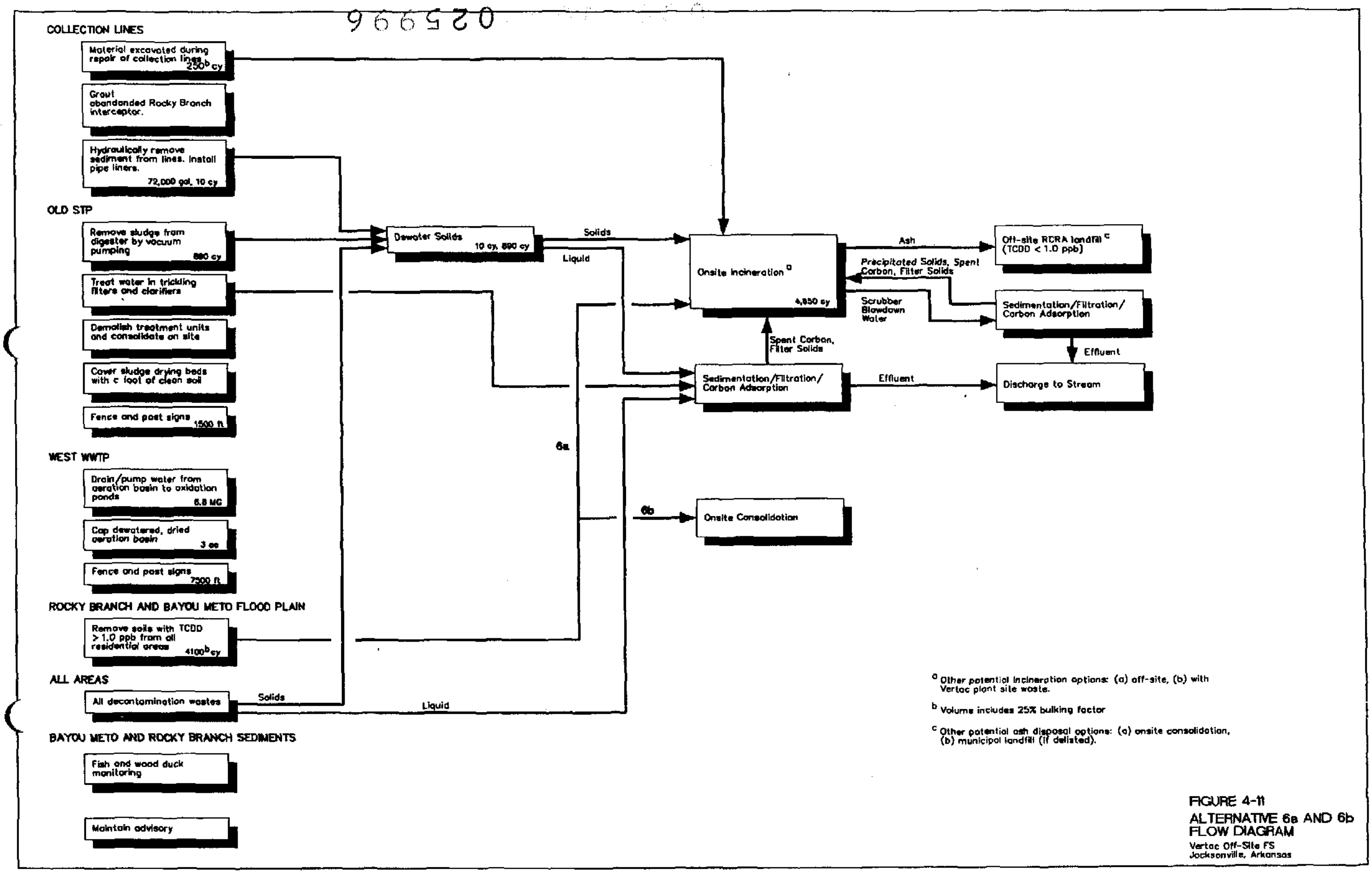

[a] Other potential incineration options: (a) off-site, (b) with Vertac plant site waste.

[b] Volume includes 25% bulking factor

[c] Other potential ash disposal options: (a) onsite consolidation, (b) municipal landfill (if delisted).

FIGURE 4-11
ALTERNATIVE 6a AND 6b
FLOW DIAGRAM
Vertac Off-Site FS
Jacksonville, Arkansas

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In Alternatives 6a and 6b, the abandoned section of the Rocky Branch Creek Interceptor will be filled with grout to reduce the migration of contaminants in the line. Sections of the abandoned interceptor collapsed during construction of the new interceptor in 1978. A sewer lamping study conducted in February 1985 revealed that sections of the interceptor are plugged with debris, grease, or trash. One or more of the manholes have been reported to have collapsed.

The grout will be placed in the old interceptor directly from a ready-mix truck. Grouting will begin at the manhole on the lowest end of the line (near the treatment plant). The grout will be poured into the manhole, and a concrete vibrator will be used to force the grout into the interceptor. Pouring will be discontinued when the level is just above the interceptor, and no additional grout can be forced into the line. The operation will then move to the next manhole up the line, and continue until the end of the abandoned line is reached.

The new interceptor was installed in close proximity to the old interceptor. In several locations, the lines cross each other, and lateral lines pass through the old interceptor before connecting to the new interceptor. Care must be exercised to ensure that the new interceptor and the lateral lines are not affected by the grouting operation. The Jacksonville Sewage Treatment Authority should be consulted to safeguard the operation.

The effectiveness of this alternative is reduced by the uncertainty regarding the condition of the abandoned interceptor and manholes. Concrete grout will not be able to reach the entire length of the interceptor between manholes (over 300 feet in some cases), even if the line is intact. Solids and debris in the lines will reduce the likelihood that a seal between the grout and the clay interceptor can be achieved. Some contamination may be forced out of the interceptor into surrounding soils through breaks in the line.

Alternatives 6a and 6b--Old STP

In both Alternatives 6a and 6b, the sludge in the digester would be pumped out, dewatered, and incinerated as in Alternative 5. Water contained in the trickling filters and clarifiers would be pumped out and treated through a filtration and carbon adsorption process. Clean water would be discharged to Rocky Branch Creek and the carbon and filter solids would be incinerated.

The old sewage treatment plant will be demolished, and buried onsite. The primary clarifiers, sludge digester, trickling filters, and curbs from the sludge drying beds, along with the pump house and associated structures will be torn down, using conventional construction techniques, and the rubble reduced to debris suitable for burial. The secondary clarifiers, which are below grade, will be filled with demolition debris. Remaining debris, including filter media from the trickling filters, will be consolidated in an area over the secondary clarifiers, and compacted for stability. The fill area will be covered with a minimum of one foot of clean soil. The sludge drying beds will also be covered with one foot of clean soil.

The irregular nature of the demolition debris may cause settlement of the soil cover over time. Seeding of the cover soil will be required to reduce erosion. Periodic inspection and maintenance will be required, including addition of soil and seeding to repair the cover.

Deed notices will be placed to restrict access and development of the old STP area.

Alternatives 6a and 6b--West WWTP

The aeration basin would be dewatered, the water treated, and the carbon and filter solids incinerated as in Alternative 4. The dikes of the aeration basin would be demolished by mechanically pushing the dike soils into the basin. The entire basin would then be covered by 1 foot of clean soil.

Notices would be placed in the deeds to restrict access and use of the West WWTP.

Alternative 6a--Rocky Branch Creek and Bayou Meto Flood Plain

This alternative would be identical to Alternative 5: All soils with greater than 1 ppb TCDD would be excavated and incinerated.

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Alternative 6b--Rocky Branch Creek and Bayou Meto Flood Plain

In Alternative 6b, the excavated soils would be consolidated onsite and capped. Approximately 4,100 cy of soil would require consolidation. Since the material consists largely of contaminated native soil, it is assumed that it would be compactable and that compaction would reduce the volume of soil by 25 percent. For consolidation, the material would be placed on the plant site and compacted into a mound with a shape and size resembling that shown in Figure 4-4.

A multilayer cap (shown previously in Figure 4-5) would then be placed over the contaminated materials. The cap would be consistent with federal and state RCRA requirements for landfill closure. The overall surface area required for consolidation would be roughly 1 acre. The native materials required for construction of the cap would be 800 cy of topsoil and sand; 2,400 cy of native soil; and 3,250 cy of clay. Based on soil descriptions in the Jacksonville area, it is expected that materials suitable for cap construction are available locally.

Alternatives 6a and 6b--Rocky Branch Creek and Bayou Meto Sediment

Alternatives 6a and 6b would be identical to the previous alternatives: no action with a continued advisory against fish ingestion and further monitoring of fish and wildlife.

COMMON REMEDIAL ACTIVITIES

Incineration, solids dewatering, wastewater treatment, and health and safety are remedial activities that are common to more than one remedial action alternative. To reduce repetition, these activities are discussed under separate headings below. 002600

Incineration

This section discusses onsite incineration and related issues for Alternatives 2 through 6. Each of these alternatives includes onsite incineration with an assumed "mobile" or "transportable" rotary kiln incinerator. The use of the rotary kiln process was selected for detailed development and evaluation due to versatility in treating a range of wastes, successful use at several hazardous waste sites, and success in destroying TCDD wastes.

There is a range of trailer-mounted rotary kiln incineration equipment available from several incineration vendors. Three basic system sizes currently available on the market include:

- **Small mobile system.** Approximately 5,000,000 to 10,000,000 Btu per hour; one or two standard semitrailers; maximum processing rate of 0.5 to 1 tons per hour of low Btu content, low moisture content contaminated soils.

- **Large mobile system.** Approximately 30,000,000 Btu per hour; 3 to 10 standard semitrailers; maximum processing rate of 4 to 5 tons per hour of low Btu content, low moisture content contaminated soils.

- **Transportable system.** Approximately 60,000,000 Btu per hour; approximately 50 to 70 standard semitrailers (complete modularized ancillary support facilities, high degree of system redundancy); maximum processing rate of 15 to 25 tons per hour of low Btu content, low moisture content contaminated soils.

The trailer-mounted incineration technology has been developing rapidly in recent years. Several vendors are currently developing more efficient systems that minimize combustion air and allow higher waste throughput. Improvements in waste feed systems, process operation for wastewater minimization, and air emission control systems are also under development.

The actual size and type of incinerator would be determined by competitive bidding and would depend on waste volumes, waste characteristics, site location constraints, utility support requirements, and final performance specifications for incineration.

Potential alternative-specific incineration scenarios for the Vertac off-site wastes are shown in Table 4-2.

Basic System Description. A generic rotary kiln process flow diagram is shown in Figure 4-12. A schematic of a small mobile rotary kiln incineration system used by the EPA to destroy TCDD wastes in Missouri is shown in Figure 4-13. Assumed onsite rotary kiln incineration systems for Alternatives 2 through 6 would include:

- **Feed storage.** Feed storage would include a minimum 1-week inventory of solid wastes to allow for continuous operations. An enclosed feed

Table 4-2 Alternative-Specific Rotary Kiln Incineration Scenarios					
Alternative	**Assumed Waste Volume for Incineration Tons**	**Probably Rotary Kiln System**	**Approximate Footprint Size (acres)**	**Approximate Incineration Rate (tons/hour)**	**Incinerator Operating Time (months)[a]**
2	260	Small mobile system	0.25 to 0.5	0.3 to 1	0.5 to 1.5
3	3,400	Small to large mobile system	0.5 to 1.0	1 to 3	2 to 7
4	11,900	Large mobile or transportable system	1.0 to 2.0	3 to 15	2 to 8
5	22,000	Large mobile or transportable system	1.0 to 2.0	3 to 15	3 to 14
6[a]	4,650	Small to large mobile system	.75 to 1.25	2 to 4	2 to 7

[a]Based on 70 percent operating factor (17 hours per day).

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026002

026003

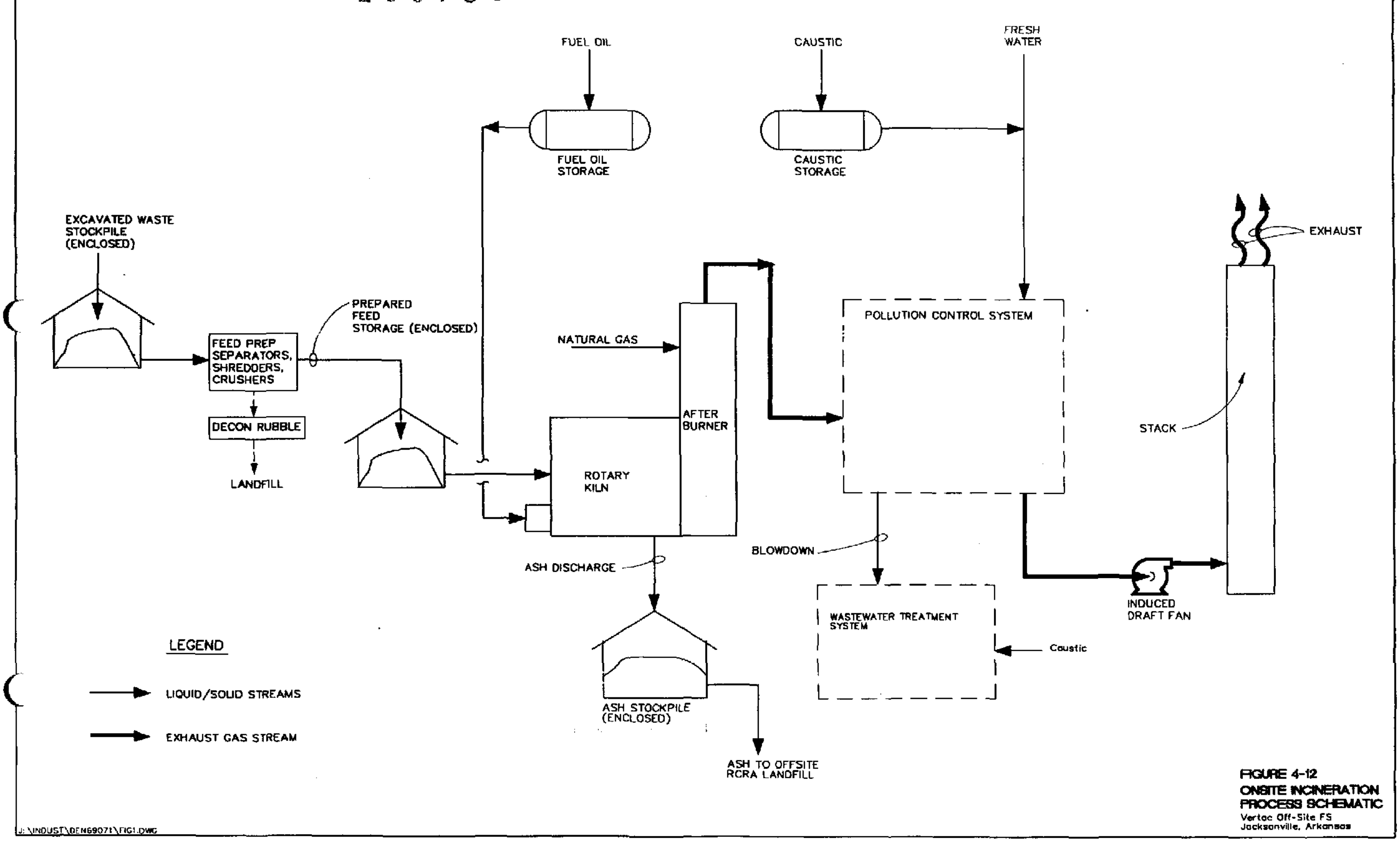


FIGURE 4-12
ONSITE INCINERATION PROCESS SCHEMATIC
Vertac Off-Site FS
Jacksonville, Arkansas

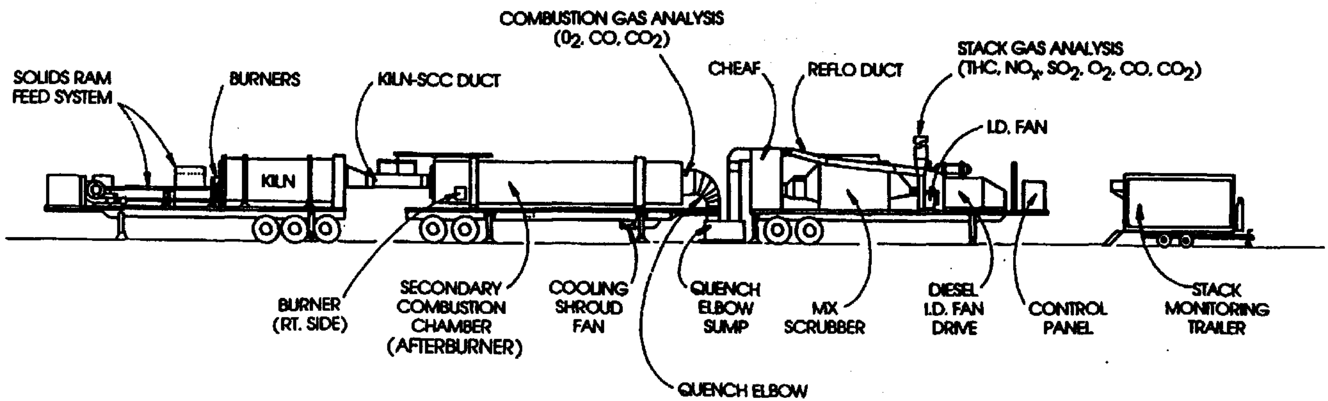


FIGURE 4-13

MOBILE ROTARY KILN INCINERATOR
Vertac Off-Site FS
Jacksonville, Arkansas

026004

building would likely be needed for control of fugitive particulate emissions. Conveyor systems or other feed systems would be enclosed.

- **Feed preparation.** The waste feed may require some waste size classification and/or size reduction processing prior to incineration. Any large rocks or heavy objects greater than 4 to 6 inches in diameter wouldrequire waste feed preparation. Depending on the quantity and nature of the objects they may be processed through shredders or crushers and fed to the incinerator or separated out, decontaminated, and sent to a RCRA (or, if possible, a sanitary) landfill. 026005

- **Primary and secondary combustion chambers.** Organic wastes are destroyed by combustion in the primary and secondary combustion chambers. The efficiency of combustion is dependent on temperature, residence time, and contacting of fuel, combustion air, and waste materials. In accordance with the January 1989 Title 40 Code of Federal Regulations (CFR) Part 264 Subpart O, incinerators at Superfund sites must provide 99.9999 percent destruction and removal efficiency (six nines DRE) for F-listed hazardous wastes. Typical operating temperatures to achieve such DREs are 1,800°F for primary combustion chambers and 2,200°F for secondary combustion chambers.

- **Air pollution control system.** Air emissions from incineration depend on several factors, including:

    - Waste composition
    - Feed rate and method
    - Combustion design
    - Combustion air rate
    - Air emission control systems

The first four factors determine the type and rate of air pollutants generated, and the fifth determines the percentage of these pollutants discharged into the atmosphere. Typical air emissions control systems include a combination of quench towers, scrubbers, demisters, electrostatic precipitators, and fabric filters. For this study, the assumed air emission control systems include quench towers, wet scrubbers, and demisters.

Table 4-3 lists general air contaminants and pertinent air regulations and standards for incineration.

026006

- **Wastewater processing and treatment system.** Typically, onsite rotary kiln incineration systems generate scrubber blowdown brine that must be treated before discharge. Scrubber water is typically recycled within the system to minimize blowdown. In this study, it is assumed that blowdown brine would be treated with a pH adjustment/precipitation system with filtration and solids dewatering. Dewatered solids would be managed as RCRA-listed wastes and probably would require disposal at a RCRA landfill. The TCDD concentration in the extract from the dewatered solids must be less than 1 ppb to meet land disposal restrictions (LDR), as determined by the toxicity characteristic leaching procedure. Treated wastewater would be managed as RCRA-listed wastes and probably would be discharged to surface water under National Pollutant Discharge Elimination System (NPDES) discharge criteria.

  Alternately, it may be possible to evaporate/concentrate the blowdown brine to form solid wastes that would likely require disposal at a RCRA landfill (subject to LDR).

Table 4-3
Air Contaminants, Regulations, and Standards

Air Contaminant	Pertinent Air Regulation	Emission Standard
Particulate Matter (PM)	PM-10[a]	50 $\mu g/m^3$ annual arithmetic mean (AAM) 150 $\mu g/m^3$ (24-hour max)[d]
	40 CFR 264.340[b]	0.08 grains/dscf
Sulfur Dioxide (SO_2)	PAAQS[c]	80 $\mu g/m^3$ or 0.03 ppm (AAM) 365 $\mu g/m^3$ or 0.114 ppm (24-hour max)[d]
	40 CFR 264.340	10,000 $\mu g/m^3$ or 9 ppm (8-hour max)[d] 40,000 $\mu g/m^3$ or 35 ppm (1-hour max)[d] 100 ppm 1-hour rolling average) 500 ppm (10-minute rolling average)
Carbon Monoxide (CO)	PAAQS[c]	10,000 $\mu g/m^3$ or 9 ppm (8-hour max)[d]
Nitrogen Dioxide (NO_2)	PAAQS[c]	100 $\mu g/m^3$ (max. calendar quarter arithmetic mean)
Lead (Pb)	PAAQS[c]	1.5 $\mu g/m^3$ (max. calendar quarter arithmetic mean)
Ozone	PAAQS[c]	235 $\mu g/m^3$
Hydrochloric Acid (HC1)	40 CFR 264.340	Less than 4 lb/hr or 99 percent control efficiency

[a]PM-10 = Particulate matter less than 10 microns (respirable particulates).
[b]Superfund incinerators must meet RCRA requirements as outlined in Title 40 Code of Federal regulations Part 264, Subpart 0.
[c]PAAQS = Primary Ambient Air Quality Standards (criteria pollutants).
[d]Not to be exceeded more than once per year.

026007

- **Ash storage.** A 1-week enclosed ash storage stockpile facility is assumed in this tudy. The ash would presumably be tested in batches for residual TCDD and other toxics and would be transported and disposed at a RCRA landfill.

  - **Ancillary support facilities.** Ancillary support facilities would presumably include fuel storage, onsite analytical facilities, and site personnel, decontamination, and administration trailers.

Typical Sequence for Onsite Incineration. For all alternatives, a basic sequence of events for onsite incineration would be:

- Design (A/E)
- Bidding and Procurement
- Funding approval
- Design (Contractor)
- Substantive permit requirements
- Public meetings
- Site preparation
- Incinerator mobilization and setup
- Shakedown and startup
- Trial burn
- Onsite incinerator operation
- Decontamination and demobilization

While certain activities may be shorter in duration for smaller systems (e.g., mobilization and setup), other activities may not vary with the system size (e.g., substantive permit requirements). The total time to remediate for each alternative is presented in the evaluation of alternatives.

Incinerator siting. Incinerator siting would depend on the size of system mobilized, ancillary support requirements, and site-specific limitations.

Other Incineration Options. There are currently no incineration facilities off the site with permits to burn dioxin wastes.

At least one facility off the site currently has an approved RCRA Part B permit, is permitted to burn PCB wastes, and has applied for a permit to burn dioxin wastes. Even with the approval to burn dioxin wastes, incineration off the site would likely not be cost-effective, even for the relatively small volume in Alternative 2. Incineration off the site probably would require:

- Drum purchase
- Handling and drumming of TCDD wastes
- Transport of drummed wastes several hundred miles
- Incineration at premium prices (costs would likely be significantly greater than the approximate $2,000 per ton rate to incinerate drummed PCB wastes)

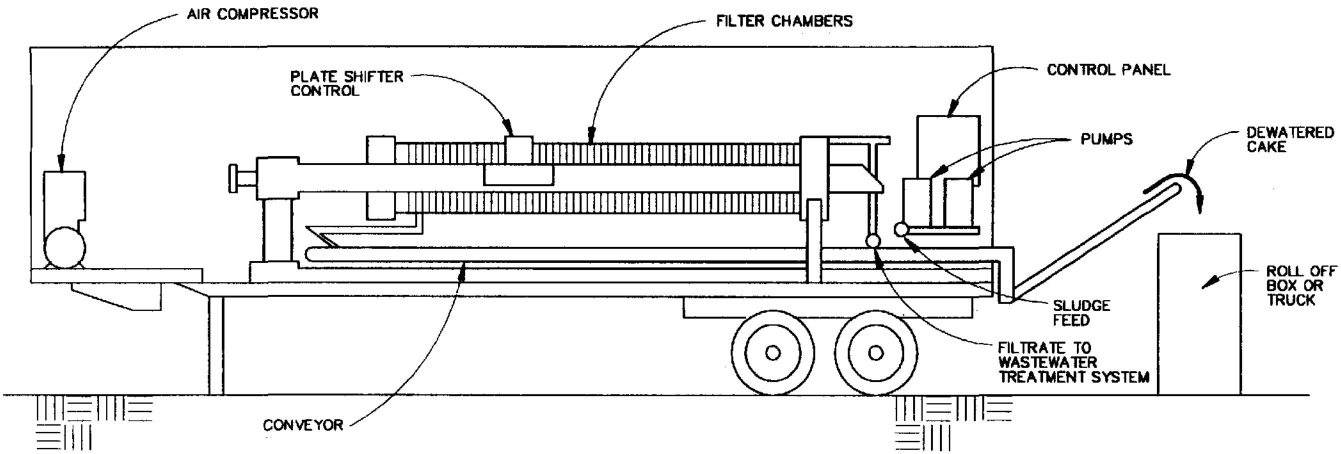
If the option of incineration with Vertac Plant site (onsite) wastes was available and implementable, the Vertac off-site wastes could be incinerated in a most cost-effective manner. An onsite incinerator is in the process of being constructed at the Vertac site to burn onsite wastes. Fixed costs for mobilization, setup, and substantive permit requirements would be incurred only once.

Solids Dewatering

A mobile plate-and-frame filter press (Figure 4-14) would be employed for dewatering sludge and sediment under Alternatives 2 through 5. Approximately 900 cy of material would be dewatered in Alternatives 2 through 4, and 6, whereas approximately 9,000 cy of material would be dewatered under Alternative 5. Table 4-4 lists the materials to be dewatered, their volumes, and assumed solids contents.

The mobile plate-and-frame filter presses available typically have capacities of 2.0 to 2.5 cy per cycle. Cycle times vary depending on the material being treated, but 1.5 hour is a representative duration. One of those dewatering units would be adequate for implementing Alternatives 2, 3, 4, or 6, while multiple units would be employed if Alternative 5 were implemented. Vendors that supply this type of equipment are located within 500 miles of the Vertac site. The availability of any given type of mobile dewatering system will depend on the demand at that time.

It is likely that polymer conditioning would enhance the dewaterability of the sludges/ sediments. Precoat chemicals may or may not be required. Other costs associated with solids dewatering include equipment rental, unit transportation and setup, labor and electricity for operation, filter media, health and safety, decontamination, and treatment/disposal of materials.



J:\INDUST\DEN69071\FIGURE-5.DWG

026011

FIGURE 4-14

MOBILE PLATE-AND-FRAME FILTER PRESS

Vertac Off-Site FS
Jacksonville, Arkansas

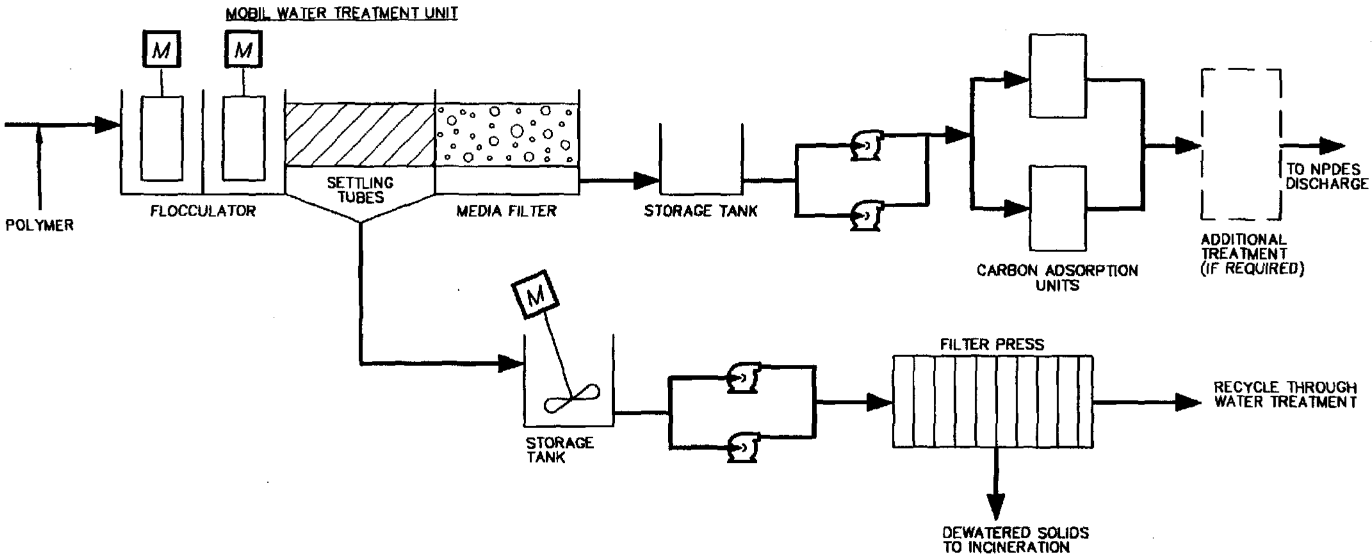
Table 4-4 Solids Dewatering Data			
Alternative	**Material**	**Estimated Initial Volume (cy) Assumed Solids Content**	**Estimated Final Volume (cy) Assumed Solids Content**
2-4, and 6	Collection line sediment	10 (20%)	6.7 (30%)
	Digester sludge	890 (5%)	300 (15%)
5	Digester sludge	890 (5%)	300 (15%)
	Primary clarifier sediment	90 (5%)	30 (15%)
	Aeration basin sediment	8,000 (5%)	2,700 (15%)

Wastewater Treatment

Use of a mobile water treatment system is assumed for treating miscellaneous wastewater in Alternatives 2 through 6. Table 4-5 lists wastewater information for these alternatives.

Figure 4-15 shows a wastewater treatment schematic for the mobile treatment processes conceptualized in these alternatives. The use of carbon adsorption treatment is consistent with the current onsite treatment of leachate collected in the French drain system.

The actual treatment process required would depend on NPDES discharge requirements. There are no promulgated standards for dioxin in surface or drinking water and there are no published, substantiated criteria for use in development of NPDES Permits. However, advisories from the May 1, 1986, Quality Criteria for Water indicate



NOTE: MEDIA FILTER BACKWASH SYSTEM NOT SHOWN

FIGURE 4-15
WASTEWATER TREATMENT PROCESS SCHEMATIC

Vertac Off-Site FS
Jacksonville, Arkansas

J:\INDUST\DEN69071\FIGURE-2.DWG

026013

Table 4-5 Volume and Disposition of Wastewater From Alternatives 2 Through 6			
Alternative	**Description**	**Estimated Volume (gallons)**	**Disposition**
2,3,4,6	Filtrate from dewatering sewer sediments after hydraulic flushing	72,000	Treat in mobile system; NPDES discharge
	Filtrate from dewatering sludge digester sludge	130,000	Treat in mobile system; NPDES discharge
	Decontamination and miscellaneous liquids	50,000	Treat in mobile system; NPDES discharge
	Pump water from aeration basin	6,800,000	Discharge to oxidation ponds
5	Wastewater from primary clarifiers	126,000	Discharge to oxidation ponds
	Wastewater from oxidation ponds and aeration basin	37,000	Discharge to oxidation ponds
	Decontamination liquids and miscellaneous collected wastewater	50,000	Discharge to oxidation ponds
Note: Scrubber blowdown discussed under general discussion of incineration. NPDES permit not required but must meet substantive requirements.			

extremely low concentration levels for concern with dioxin in water. The advisory includes a concentration of 1.3×10^{-8} ppb dioxin n water for protection of human health at the cancer risk level of 1×10^{-6}. The same document includes advisories for the protection of aquatic life that ranges from 0.04 ppb to 1×10^{-5} ppb, depending on the species examined.

NPDES discharge criteria could substantially increase the treatment requirements over the assumed scenario in this study. Analytical requirements could also be significantly increased depending on the NPDES-required monitoring frequency and concentrations. NPDES requirements for non-TCDD compounds could also affect water treatment and analytical requirements for these alternatives.

Site Health and Safety

The following site health and safety related assumptions were made in developing Alternatives 2 through 6. The Occupational Safety and Health Act (29CFR1910) requirements for worker protection, training, and monitoring are applicable to all remedial actions at the site (including ancillary treatment systems). Specific health and safety activities will depend on site-specific remediation activities and specific agency requirements.

- Work tasks where direct contact with TCDD contaminated materials are assumed to require Level C health and safety protection (full-face air purifying respirator, disposable coveralls, and ancillary boots and gloves). Support workers outside of areas where TCDD dust may be significant are assumed to require Level D health and safety protection (disposable coveralls, ancillary boots and gloves, and readily available respiratory protective equipment).

- Perimeter particulate monitoring around excavation areas is assumed.

- A trial burn with stack emissions testing, including destructive removal efficiencies (DRE) of principal organic hazardous constituents (POHC), would be completed for incineration. The incinerator stack would be monitored continuously during operation for carbon monoxide and possible carbon dioxide and oxygen content.

- Operations where TCDD wastes are removed/handled will require personnel decontamination and equipment decontamination facilities.

- High temperatures during removal activities could significantly reduce labor efficiencies

- Contaminated solid wastes (e.g., PPE equipment) would presumably be fed to the incinerator

- Liquid wastes (e.g., decontamination water) would presumably be fed to the water treatment system

026016

Section 5

Detailed Analysis of Alternatives

Section 5

DETAILED ANALYSIS OF ALTERNATIVES

The purpose of the detailed analysis of alternatives is to provide information that decisionmakers need to compare the alternatives, select a site remedy, prepare the proposed plan, and demonstrate that CERCLA requirements are satisfied.

STATUTORY REQUIREMENTS

EPA describes statutory requirements for a detailed analysis of alternatives in its *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA, 1989). Some of the text is excerpted below.

> The specific statutory requirements for remedial actions that must be addressed in the ROD and supported by the FS report are listed below. Remedial actions must:
>
> - Be protective of human health and the environment
> - Attain ARARs (or provide grounds for invoking a waiver)
> - Be cost-effective
> - Utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable

- Satisfy the preference for treatment that reduces toxicity, mobility, or volume as a principal element or provide an explanation in the ROD as to why it does not

In addition, CERCLA places an emphasis on evaluating long-term effectiveness and related considerations for each of the alternative remedial actions (Section 121(b) (1) (A)). These statutory considerations include:

A) The long-term uncertainties associated with land disposal

B) The goals, objectives, and requirements of the Solid Waste Disposal Act

C) The persistence, toxicity, and mobility of hazardous substances and their constituents, and their propensity to bioaccumulate

D) Short- and long-term potential for adverse health effects from human exposure

E) Long-term maintenance costs

F) The potential for future remedial action costs if the alternative remedial action in question were to fail

G) The potential threat to human health and the environment associated with excavation, transportation, redisposal, or containment

EVALUATION CRITERIA

The EPA guidance document presents nine evaluation criteria developed to address the CERCLA requirements and considerations listed above. These criteria also address technical and policy considerations that have proven important in selecting remedial alternatives. These evaluation criteria are the basis for the detailed analyses conducted during an FS and for the subsequent selection of an appropriate remedial action.

Figure 5-1 lists the nine evaluation criteria along with the issues they address.

THRESHOLD CRITERIA

The first two criteria relate directly to statutory requirements for any remedial action and must be addressed in the ROD. For this reason, these are considered threshold criteria, which must be met by each alternative.

Briefly, these two criteria are:

- Overall protection of human health and the environment: how the alternative reduces the risk of human exposure and contaminant migration in the environment.

- Compliance with applicable or relevant and appropriate requirements (ARARs): how the alternative complies with federal and state ARARs. Three types of ARARs--chemical-specific, location-specific, and action-specific--are considered. This criterion also addresses compliance with other advisories, criteria, and guidance that agencies have agreed are "to be considered" (TBCs).

026020

THRESHOLD CRITERIA

OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

- How Alternative Protects Human Health and the Environment

COMPLIANCE WITH ARARs (Applicable or relevant and and appropriate requirements)

- Compliance With Chemical-Specific ARARs
- Compliance With Action-Specific ARARs
- Compliance With Location-Specific ARARs
- Compliance With Other Criteria, Advisories and Guidelines that Agencies Agree are "To Be Considered" (TBCs)

PRIMARY CRITERIA

LONG-TERM EFFECTIVENESS AND PERMANENCE

- Magnitude of Residual Risk
- Adequacy and Reliability of Controls on Remaining Wastes

REDUCTION OF TOXICITY MOBILITY, AND VOLUME THROUGH TREATMENT

- Amount of Hazardous Materials Destroyed or Treated
- Degree of Expected Reductions in Toxicity, Mobility, and Volume
- Degree to Which Treatment is Irreversible
- Type and Quantity of Residuals Remaining After Treatment

SHORT-TERM EFFECTIVENESS

- Protection of Community During Remedial Actions
- Protection of Workers Involved With the Remedial Action
- Environmental Impacts of the Remedial Action
- Time Until Remedial Action is Completed

IMPLEMENTABILITY

- Ability to Construct and Operate the Technology
- Reliability of the Technology
- Ease of Undertaking Additional Remedial Actions, if Necessary
- Ability to Monitor Effectiveness of Remedy
- Ability to Obtain Approvals From Other Agencies
- Coordination With Other Agencies
- Availability of Off-site Treatment, Storage, and Disposal Services and Capacity
- Availability of Necessary Equipment and Specialists
- Availability of Prospective Technologies

COST

- Capital Cost
- Operating and Maintenance Cost
- Present Worth Cost

MODIFYING CRITERIA

STATE ACCEPTANCE

COMMUNITY ACCEPTANCE

- Addressed Following Public Comment on the RI/FS Report and the Proposed Plan When Record of Decision is Prepared

FIGURE 5-1

CRITERIA FOR DETAILED ANALYSIS OF ALTERNATIVES

Vertac Off-Site FS
Jacksonville, Arkansas

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(A general discussion of ARARs and an overview of ARARs that pertain to the Vertac off-site area follow these criteria descriptions.)

PRIMARY CRITERIA

Criteria 3 through 7 are primary criteria upon which the analysis of alternatives is based. These encompass technical, institutional, risk, and cost concerns.

These five criteria are:

- Long-term effectiveness and permanence: the long-term effectiveness of the alternative in protecting human health and the environment. The evaluation is based on the magnitude of residual risk remaining and the adequacy and reliability of controls used to manage the remaining waste.

- Reduction of toxicity, mobility, or volume through treatment: addresses the statutory preference for a remedial action that employs treatment to permanently reduce the toxicity, mobility, or volume of hazardous waste. Components of this criterion include:

    - The treatment process used, and the materials treated
    - The amount of waste destroyed
    - The reduction in toxicity, mobility, or volume
    - Degree of expected reductions in toxicity, mobility, and volume
    - The irreversibility of treatment
    - The type and quantity of residuals remaining after treatment

- Short-term effectiveness: protection of the community and workers during remediation; the environmental impacts of implementing the remediation; and the time required to achieve remedial action objectives.

- Implementability: the technical and administrative feasibility of the alternative and the availability of required equipment, services, and materials.

  - Technical feasibility encompasses the ability to construct and operate the components of the alternative, the reliability of the technology, the ease of undertaking additional remediation, and the ability to monitor effectiveness of the action.

  - Administrative feasibility includes ability to obtain required approvals from and coordination with other agencies.

- Cost: the capital, operating and maintenance, and present value costs of the alternative.

MODIFYING CRITERIA

Criteria 8 and 9, State and Community Acceptance, are modifying criteria, which are addressed after public comment on the RI/FS report and the proposed plan, and while the ROD is being prepared.

GENERAL DISCUSSION OF ARARs

The basis of the ARARs compliance criteria is a Congressional mandate in Section 121(d) of the 1986 Superfund Amendments and Reauthorization Act (SARA).

This section says that site cleanups conducted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) must comply with the requirements of all federal and state environmental and public health laws. These laws are known in the Superfund program as applicable or relevant and appropriate requirements (ARARs). Generally, they are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law. Appendix C presents ARARs background information. Specific definitions follow.

020624

APPLICABLE REQUIREMENTS

Applicable requirements specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.

"Applicability" implies that the remedial action or the circumstances at the site satisfy all of the jurisdictional prerequisites of a requirement. For example, the minimum technology requirement for landfills under RCRA would apply if a new hazardous waste landfill unit (or an expansion of an existing unit) were to be built on a CERCLA site.

RELEVANT AND APPROPRIATE REQUIREMENTS

Relevant and appropriate requirements, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. However, in some circumstances, a requirement may be relevant but not appropriate for the site-specific situation. A requirement judged relevant and appropriate must be complied with to the same degree as if it were applicable.

CRITERIA "TO BE CONSIDERED" (TBCs)

In addition to legally binding laws and regulations, many federal and state environmental and public health programs also develop criteria, advisories, guidance, and proposed standards that are not legally binding, but that may provide useful information or recommended procedures. If no ARARs address a particular situation, or if existing ARARs do not ensure protection, these criteria to be considered (TBCs) may be used to establish protective cleanup-level targets and to help identify remedial action alternatives.

0 2 6 0 2 5

CATEGORIES OF ARARs

ARARs have been divided into three categories:

- Chemical-specific
- Location-specific
- Action-specific

Chemical-Specific ARARs

These ARARs include those laws and requirements that regulate the release to the environment of materials possessing certain chemical or physical characteristics, or containing specified chemical compounds. These requirements generally set health- or risk-based concentration limits or discharge limitations for specific hazardous substances.

Location-Specific ARARs

These requirements relate to the geographical or physical position of the site, rather than to the nature of the contaminants or the proposed site remedial actions. These ARARs may limit the type of remedial actions that can be implemented, and may impose additional constraints on the clean-up action. Flood plain restrictions and the protection of endangered species are among the location-specific potential ARARs.

Action-Specific ARARs

These requirements define acceptable treatment and disposal procedures for hazardous substances. Generally, they set performance, design, or other similar action-specific controls or restrictions on activities related to management of hazardous substances or pollutants.

These requirements are triggered by the particular remedial activities selected to accomplish a remedy. The action-specific requirements do not in themselves determine the remedial alternative; rather, they indicate how a selected alternative must be achieved.

ARARs FOR THE VERTAC OFF-SITE AREA

CHEMICAL-SPECIFIC ARARs FOR THE VERTAC OFF-SITE AREA

The scope of this study includes only 2,3,7,8-TCDD as the contaminant of concern. Currently, there are no chemical-specific ARARs for 2,3,7,8-TCDD. There are, however, a number of health advisories and suggested cleanup criteria that could be TBCs for the Vertac off-site remedial action.

The most important TBC is in the April 24, 1986, memo from the Agency for Toxic Substances and Disease Registry (ATSDR) to EPA Region 6 (see Appendix B). This memo recommends cleanup levels specific to the Vertac off-site area. Another important TBC is the January 26, 1989, memo from EPA to ATSDR stating that the highest concentration of TCDD found in the Rocky Branch Creek and Bayou Meto sediments does not pose an unacceptable health threat (Appendix A).

The EPA 1-ppb action level previously employed at other TCDD-contaminated sites (EPA, 1987) is also an important TBC. That level was based on a Centers for Disease Control (CDC) recommendation developed primarily for long-term direct contact with TCDD-contaminated soils in residential areas (Kimbrough et al. 1984). 026027

Other TBCs that could be of use include proposed advisories on protection of human health and aquatic life developed under the Clean Water Act. The advisories for aquatic life are specific to individual fish species, and may have to be adjusted for conditions in Rocky Branch Creek. These criteria should be consulted to determine design goals for the wastewater treatment system included in Alternatives 2 through 6.

LOCATION-SPECIFIC ARARs FOR THE VERTAC OFF-SITE AREA

Location-specific ARARs have been evaluated for the Vertac off-site area as a whole. Table 5-1 includes the location-specific requirements identified as ARARs.

The federal regulations that form the list of potential location-specific ARARs include the Resource Conservation and Recovery Act (RCRA), the National Archaeological and Historic Preservation Act, the National Historic Preservation Act, the Endangered Species Act, the Clean Water Act, the Wilderness Act, the Fish and Wildlife Coordination Act, the Scenic Rivers Act, the Coastal Zone Management Act, the Marine

Table 5-1
Preliminary Identification of Potential Location-specific ARARs
For Vertac Off-site Area (page 1 of 2)

Location	Requirement	Prerequisite(s)	Citation	ARAR	Comments
1. Within 61 meters (200 feet) of a fault displaced in Holocene time	New treatment, storage, or disposal of hazardous waste prohibited	RCRA hazardous waste; treatment, storage, or disposal	40 CFR 264.18(a)	Not ARAR	No Holocene faults are known to exist within 61 meters of the Vertac off-site area
2. Within 100-year flood plain	Facility must be designed, constructed, operated, and maintained to avoid washout	RCRA hazardous waste; treatment, storage, or disposal	40 CFR 264.18(b)	Applicable	These requirements would be applicable to the construction and operation of new RCRA units within the 100-year flood plain
3. Within flood plain	Action to avoid adverse effects, minimize potential harm, restore and preserve natural and beneficial values	Action that will occur in a flood plain, i.e., lowlands, and relatively flat areas adjoining inland and coastal waters and other flood prone areas	Executive Order 11988, Protection of Flood Plains, (40 CFR 6, Appendix A)	Applicable	These requirements would be applicable to remedial actions within the flood plain
4. Within salt dome formation, underground mine, or cave	Placement of noncontainerized or bulk liquid hazardous waste prohibited	RCRA hazardous waste; placement of noncontainerized or bulk liquid hazardous waste	40 CFR 264.18(c)	Not ARAR	No salt domes, underground mines, or caves will be used for placement of hazardous wastes
5. Within area where action may cause irreparable harm, loss, or destruction of significant artifacts	Action to recover and preserve artifacts	Alteration of terrain that threatens significant scientific, prehistorical, historical, or archaeological data	National Archaeological and Historical Preservation Act (16 USC Section 469); 36 CFR Part 65	Not ARAR	No known scientific or historic artifacts within the boundaries of the Vertac off-site area
6. Historic project owned or controlled by federal agency	Action to preserve historic properties; planning of action to minimize harm to National Historic Landmarks	Property included in or eligible for the National Register of Historic Places	National Historic Preservation Act Section 106 (16 USC 470 et seq.); 36 CFR Part 800	Not ARAR	No historic landmarks are located within the boundaries of the Vertac off-site area
7. Critical habitat upon which endangered species or threatened species depends	Action to conserve endangered species or threatened species, including consultation with the Department of the Interior	Determination of endangered species or threatened species	Endangered Species Act of 1973 (16 USC 1531 et seq.); 50 CFR Part 200, 50 CFR Part 402	Pending	No endangered or threatened species are known to exist on the site. Awaiting confirmation of site status
8. Wetland	Action to minimize the destruction, loss, or degradation of wetlands	Wetland as defined by Executive Order 11990 Section 7	Executive Order 11990, Protection of Wetlands, (40 CFR 6, Appendix A)	Not ARAR	No remedial actions are planned for areas that could be classified as wetlands
	Action to prohibit discharge of dredged or fill material into wetland without permit		Clean Water Act Section 404; 40 CFR Parts 230, 231	Not ARAR	No remedial actions are planned for areas that could be classified as wetlands

Table 5-1
Preliminary Identification of Potential Location-specific ARARs
For Vertac Off-site Area (page 2 of 2)

Location	Requirement	Prerequisite(s)	Citation	ARAR	Comments
9. Wilderness area	Area must be administered in such a manner as will leave it unimpaired as wilderness and to preserve its wilderness character	Federally owned area designated as wilderness area	Wilderness Act (16 USC 1131 et seq.); 50 CFR 35.1 et seq.	Not ARAR	Not a wilderness area
10. Wildlife refuge	Only actions allowed under the provisions of 16 USC Section 668 dd(c) may be undertaken in areas that are part of the National Wildlife Refuge System	Area designated as part of National Wildlife Refuge System	16 USC 668 dd et seq.; 50 CFR Part 27	Not ARAR	Not a wildlife refuge
11. Area affecting stream or river	Action to protect fish or wildlife	Diversion, channeling, or other activity that modifies a stream or river and affects fish or wildlife	Fish and Wildlife Coordination Act (16 USC 661 et seq.); 40 CFR 6.302	Applicable	Any remedial actions that may adversely affect Rocky Branch or Bayou Meto must be discussed with the Department of Fish and Wildlife
12. Within area affecting National wild, scenic, or recreational river	Avoid taking or assisting in action that will have direct adverse effect on scenic river	Activities that affect or may affect any of the rivers specified in Section 1276(a)	Scenic Rivers Act (16 USC 1271 et seq. Section 7(a); 40 CFR 6.302 (e)	Not ARAR	Rocky Branch and Bayou Meto are not classified as wild and scenic rivers
13. Within coastal zone	Conduct activities in manner consistent with approved State management programs	Activities affecting the coastal zone including lands thereunder and adjacent shorelands	Coastal Zone Management Act (16 USC Section 1451 et seq.)	Not ARAR	The site is not within a coastal zone
14. Oceans or waters of the United States	Action to dispose of dredge and fill material into ocean waters is prohibited without a permit	Oceans and waters of the United States	Clean Water Act Section 404 40 CFR 125 Subpart M; Marine Protection Resources and Sanctuary Act Section 103	Not ARAR	No dredge disposal in oceans or waters of the United States is included in the remedial alternatives for the Vertac off-site area

Protection Resources and Sanctuary Act, and the Executive Orders on the Protection of Wetlands and the Protection of Flood Plains. No State of Arkansas regulations were identified that addressed other location-specific requirements or that were more strict than federal regulations.

Location-specific ARARs that will be applicable or relevant and appropriate to the Vertac off-site area include flood plain requirements and requirements under the Fish and Wildlife Coordination Act.

Flood Plain Requirements. Under RCRA, any hazardous waste treatment, storage, or disposal facility constructed within a 100-year flood plain must be designed, constructed, operated, and maintained in a manner that will avoid washout of hazardous waste during a 100-year flood (40 CFR 264.18(b)). For any activity that occurs in a flood plain, Executive Order 11988, Protection of Flood Plains, requires action to avoid adverse effects, minimize potential harm, and restore and preserve natural and beneficial values.

Since the Vertac off-site area is within a flood plain, Alternatives 2 through 6 must comply with the requirements listed above. For Alternatives 2 and 6b, the RCRA requirements would be especially important for onsite consolidation. Construction of treatment facilities in Alternatives 2 through 6 would also be subject to the RCRA requirements.

Fish and Wildlife Coordination Act. Any action that might modify or adversely affect a river or stream is subject to review by the state fish and wildlife agency under the Fish and Wildlife Coordination Act. This act requires protection of fish and wildlife in riparian areas. Discharge of treated wastewater effluent and continued discharge of water from the oxidation ponds would require coordination with ADPC&E.

ACTION-SPECIFIC ARARs FOR THE VERTAC OFF-SITE AREA

Table C-1 (Appendix C) identifies potential action-specific ARARs. Action-specific ARARs are discussed further in the analysis of each alternative.

RCRA ARARs

EPA has made several determinations regarding RCRA ARARs at the Vertac off-site areas. These are presented below and discussed in greater detail in Appendix C.

Wastes that are part of a permitted discharge to a publicly-owned treatment plant (POTW) are regulated under the Clean Water Act and are exempt from regulation under RCRA as long as the wastes remain in place. Therefore, RCRA hazardous waste management requirements are not applicable to wastes in the collection lines, Old STP, or West WWTP. For the collection lines, EPA has determined that RCRA may be relevant but not appropriate due to depth of the lines (3 to 15 feet) and the absence of a direct exposure route. Similarly, for the Old STP and West WWTP, RCRA is relevant but not appropriate because of the low TCDD concentrations, which are below ATSDR action levels (except for sludge digester). EPA has determined that material removed from the collection lines or sludge digester must meet RCRA hazardous waste management requirements.

The Rocky Branch Creek and Bayou Meto flood plain soils do not represent a RCRA unit and, therefore, RCRA is not applicable. However, if soils or sediments are excavated, they must be managed in accordance with RCRA hazardous waste management requirements.

The results of the comparative analysis are presented to identify the key tradeoffs between the alternatives.

INDIVIDUAL ANALYSIS

The analysis of each alternative is summarized in an accompanying table. Each alternative developed for the Vertac off-site area consists of remedial actions for each of the five areas under consideration:

- The sewage collection lines
- The Old (abandoned) STP
- The West WWTP
- The Rocky Branch Creek and Bayou Meto flood plain
- Rocky Branch Creek and Bayou Meto Sediments

The summary tables of the individual analyses results are formatted to evaluate the remedial action proposed for each of these areas under each alternative. Further discussion appears below under the heading for each alternative. Appendix D presents a detailed analysis of the costs associated with each alternative.

ALTERNATIVE 1

Table 5-2 summarizes the analysis of Alternative 1 (no action). The no-action alternative is required by the NCP and provides a baseline to which other alternatives can be compared.

Another important RCRA determination addresses the ash generated from incineration in each of the alternatives. The status of ash from incineration depends on the material being burned:

- Ash from incineration of dioxin wastes must meet a treatment standard (less than 1 ppb of dioxin in extract from TCLP test) before it can be disposed of in land-based RCRA-hazardous-waste disposal units.

- The ash generated by incinerating FO20-listed hazardous waste is classified as a hazardous waste (FO28).

- The ash from incinerating wastes and soils <u>not</u> classified as hazardous is not classified as a hazardous waste.

- If the hazardous and nonhazardous ash are mixed, the mixture is a listed waste.

STEPS IN THE DETAILED ANALYSIS

The detailed analysis of alternatives involves two steps:

- Individual analysis of alternatives
- Comparative analysis of alternatives

This detailed analysis begins by evaluating each alternative individually against the criteria in Figure 5-1. Following the individual analyses, a comparative analysis assesses the relative performance of each alternative with respect to the evaluation criteria.

EVALUATION CRITERIA	COLLECTION LINES	OLD STP	WEST WWTP	ROCKY BRANCH CREEK AND BAYOU METO FLOOD PLAIN	ROCKY BRANCH CREEK AND BAYOU METO SEDIMENTS
	No action	No action	No action	No further action. Fences and signs currently restrict access from residential area to Rocky Branch Creek and soil with TCDD between 1.0 and 5.0 ppb.	No further action. Continued advisory against ingestion of fish from affected areas. Continue fish and wildlife monitoring.
1. OVERALL PROTECTIVENESS					
Human health protection	Does not address the potential risk of exposure to contaminated sediments in and surrounding the collection lines (e.g. due to sewer overflows or during sewer line repairs).	Does not address the risk of exposure to contaminated material in the sludge digester, sludge drying beds, and clarifiers, nor the risk of agricultural use of the drying beds.	Does not address the risk of exposure to contaminated sediments in the aeration basin and oxidation ponds.	Does not address the risk of exposure/ingestion of soils with TCDD > 1.0 ppb remaining in undeveloped residential areas.	Proctective of human health as determined by EPA and ATSDR
Environmental protection	Does not address the potential for migration of contaminated sediments in and surrounding the collection lines.	Does not address the potential for migration of contaminated soil from the drying beds during flooding. *(Other contamination is contained within treatment facilities)*	Does not address the potential for migration of contaminated sediments from the aeration basin and oxidation ponds.	Does not address the potential for migration of contaminated flood plain soils.	Continued fish and wildlife monitoring to address environmental effects.
2. COMPLIANCE WITH ARARs	Does not achieve ATSDR recommendations.	Does not achieve ATSDR recommendations.	Does not achieve ATSDR recommendations.	Does not achieve ATSDR recommendations.	Complies with EPA and ATSDR action level recommendations
3. LONG-TERM EFFECTIVENESS AND PERMANENCE					
Magnitude of residual risk	Does not reduce the risk from present conditions.	Does not reduce the risk from present conditions.	Does not reduce the risk from present conditions.	Does not reduce the risk from present conditions.	Fish advisory will reduce human health risks
Adequacy and reliability of controls	Not applicable	Not applicable	Not applicable	Not applicable	Effectiveness dependent on fish advisory
4. REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT					
Amount destroyed or treated	None	None	None	None	None
Reduction of toxicity, mobility, or volume	None	None	None	None	None
Irreversibility of treatment	Not applicable	Not applicable	Not applicable.	Not applicable.	Not applicable.
Type and quantity of residuals remaining after treatment	Not applicable	Not applicable	Not applicable.	Not applicable.	Not applicable.
5. SHORT-TERM EFFECTIVENESS					
Community protection	Risk to community not increased by alternative implementation.	Risk to community not increased by alternative implementation.	Risk to community not increased by alternative implementation.	Risk to community not increased by alternative implementation.	Risk to community not increased by alternative implementation.
Worker protection	Not applicable	Not applicable	Not applicable.	Not applicable.	Not applicable
Environmental impacts	Existing impacts not changed	Existing impacts not changed	Existing impacts not changed.	Existing impacts not changed.	Existing impacts not changed
Time until action is completed (After ROD is signed)	Not applicable	Not applicable	Not applicable.	Not applicable.	Not applicable.
6. IMPLEMENTABILITY					
Technical feasibility	Not applicable	Not applicable	Not applicable	Not applicable	Technically feasible.
Administrative feasibility	Not applicable	Not applicable	Not applicable	Not applicable	Administratively feasible
Availability of services and materials	Not applicable	Not applicable	Not applicable	Not applicable	Services and materials available
7. COST	$0	$0	$0	$0	

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TABLE 5-2
INDIVIDUAL ANALYSIS OF ALTERNATIVE 1

Vertac Off-Site FS
Jacksonville, Arkansas

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Alternative 1--Overall Protectiveness. Because no further remedial action would be implemented under Alternative 1, the overall risks to human health and the environment would be the same as currently exist at the site.

Alternative 1 would provide no control of direct exposure to contaminated soils in the sludge-drying beds of the Old STP or in the Rocky Branch Creek flood plain. TCDD-contaminated material is present in several other areas to which there is no direct route of exposure under current conditions, but which could constitute potential human health risks under future scenarios. This material includes the contaminated sediments/soils in and around the sewage collection lines, sludge in the old sludge digester and primary clarifiers, sediments in the aeration basin and oxidation ponds, and soil remaining in the Rocky Branch Creek flood plain. Alternative 1 also would provide no control over migration of contaminated material from those areas and subsequent environmental impacts.

The remedy for Rocky Branch Creek and Bayou Meto sediments is the same throughout alternatives, including Alternative 1. No-action with the continued advisory against fishing would achieve overall protectiveness of human health in this off-site area (see Appendix A).

Alternative 1--Compliance with ARARs. The no-action alternative would not achieve the cleanup levels recommended by ATSDR and, therefore, ARARs would not be met.

Alternative 1--Long-Term Effectiveness and Permanence. Because no further remedial action would be taken, the long-term risk would not be reduced from the present conditions.

Alternative 1--Reduction of Toxicity, Mobility, or Volume Through Treatment. This alternative provides no reduction in toxicity, mobility, or volume of contaminated material through treatment.

Alternative 1--Short-Term Effectiveness. The implementation of Alternative 1 would not create additional risk for the community, workers, or environment.

Alternative 1--Implementability. There are no implementability concerns associated with this alternative.

Alternative 1--Cost. The capital, O&M, and present worth costs of implementing Alternative 1 are $0 since no action would be taken.

ALTERNATIVE 2

Table 5-3 summarizes the evaluation of Alternative 2.

Alternative 2--Overall Protectiveness. Implementation of Alternative 2 would eliminate the risk of exposure or migration associated with contaminated sediments in the active collection lines, sludge in the digester, and soil with TCDD >5.0 ppb from the Rocky Branch Creek flood plain. Sediments from the collection lines would be incinerated and soils from the digester and flood plain would be consolidated onsite and capped. Fencing and institutional controls would reduce the risk of exposure to contaminated soil and sediment in the sludge drying beds, primary clarifiers, aeration basin, oxidation ponds, and areas of the Rocky Branch Creek flood plain with soil TCDD concentrations between 1.0 and 5.0 ppb. Maintaining the fishing advisory would be protective of public health for the Rocky Branch Creek and Bayou Meto sediments.

EVALUATION CRITERIA	COLLECTION LINES	OLD STP	WEST WWTP	ROCKY BRANCH CREEK AND BAYOU METO FLOOD PLAIN	ROCKY BRANCH CREEK AND BAYOU METO SEDIMENTS
	Hydraulically clean active lines and incinerate sediments.	Remove sludge from digester and consolidate dewatered solids onsite. Fence grounds and post signs.	Fence facilities and post signs.	Remove soil with TCDD > 5.0 ppb from undeveloped residential areas and consolidate it onsite. Restrict land use of undeveloped residential areas with TCDD between 1.0 and 5.0 ppb.	No further action. Continued advisory against ingestion of fish from affected areas. Continue fish and wildlife monitoring.
1. OVERALL PROTECTION					
Protection of human health	Eliminates the risk of exposure to contaminated sediments in the active collection lines. Does not address the risk of exposure to contaminated soil surrounding lines.	Eliminates the risk of exposure to contaminated sludge in digester. Reduces but does not eliminate the risk of exposure to sludge drying beds and other facilities or agricultural use of drying beds.	Reduces but does not eliminate risk of exposure to contaminated sediments in the aeration basin and oxidation ponds by fencing.	Reduces the risk of exposure/ingestion of contaminated soil remaining in undeveloped residential areas by removing the more highly contaminated (TCDD >5.0 ppb) sections and restricting use of areas with TCDD between 1.0 and 5.0 ppb.	Proctective of human health as determined by EPA and ATSDR Continued fish and wildlife monitoring to address environmental effects.
Environmental protection	Eliminates the potential for migration of contaminated sediments in the active collection lines. Does not address the potential for infiltration and migration of contaminated soil surrounding pipes.	Does not address potential for migration of contaminated soil from the drying beds.	Does not address the potential for migration of contaminated sediments from the aeration basin and oxidation ponds.	Reduces the potential for migration of contaminated flood plain soils by removing the more highly contaminated (TCDD > 5.0 ppb) sections.	
2. COMPLIANCE WITH ARARs	Meets ATSDR recommendations. RCRA requirements met for management of sediments removed from active line.	Meets ATSDR recommendations. RCRA requirements for management of sludge removed from digester are met.	RCRA hazardous waste management requirements are relevant but not appropriate. Meets ATSDR recommendations.	RCRA hazardous waste management requirements are applicable for management of excavated soils. These requirements would be met. Does not meet ATSDR reccommendations for soils between 1.0 and 5.0 ppb.	Complies with EPA and ATSDR action level recommendatior
3. LONG-TERM EFFECTIVENESS AND PERMANENCE					
Magnitude of residual risk	Eliminates risk associated with contaminated sediments within the active sewer lines. Does not reduce the risk associated with contaminated soil surrounding active sewer lines or in or around abandoned interceptor.	Eliminates risk associated with contaminated sludge in digester as long as consolidated material is securely contained; inherent hazard of waste remains. Does not reduce the risk associated with material in the sludge drying beds or other facilities except by restricting access and use.	Does not reduce the risk associated with contaminated sediments in the aeration basin or oxidation ponds except by restricting access.	Eliminates risk associated with flood plain soil with TCDD > 5.0ppb as long as consolidated material is securely contained; inherent hazard of waste remains. Does not reduce risk associated with contaminated soil (1.0 ppb < TCDD < 5.0 ppb) left in place except by restricting access and use.	Fish advisory will reduce human health risks Not applicable
Adequacy and reliability of controls	RCRA cap adequately contains incinerator ash in onsite consolidation area. RCRA cap is reliable if maintained. No controls over contaminated soil surrounding active sewer lines or material in and around abandoned interceptor. Incineration reliably destroys TCDD-contaminated sediments from the active sewer lines.	RCRA cap adequately contains dewatered sludge from digester in onsite consolidation area. RCRA cap is reliable if maintained. Fencing and institutional controls designed to restrict access and use of sludge drying beds and other facilities are of limited effectiveness and reliability.	Fencing and institutional controls designed to restrict access to aeration basin and oxidation ponds are of limited effectiveness and reliability.	RCRA cap adequately contains soil removed from flood plain. RCRA cap is reliable if maintained. Fencing and institutional controls designed to restrict access and use of contaminated areas are of limited effectiveness and reliability.	
4. REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT					
Amount destroyed or treated	Destroys 99.9999% of TCDD in 10 cy of sediment from active sewer lines and 250 cy of soil excavated during repair of lines by incineration.	None	None	None	None
Reduction of toxicity, mobility, or volume	Reduces MTV of contaminated sediment from active lines by 100%. Reduces volume of contaminated material associated with repair of collection lines.	None	None	None	None
Irreversibility of treatment	Incineration is irreversible. Wastewater treatment by filtration/carbon adsorption with incineration of filter solids and spent carbon is irreversible.	Wastewater treatment by filtration/carbon adsorption with incineration of filter solids and spent carbon is irreversible.	None	None	Not applicable.
Type and quantity of residuals remaining after treatment	Ash from incineration of 260 cy of soil/sediment remains.	None	None	None	Not applicable.

TABLE 5-3
INDIVIDUAL ANALYSIS OF ALTERNATIVE 2
Vertac Off-Site FS
Jocksonville, Arkansas

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EVALUATION CRITERIA	COLLECTION LINES	OLD STP	WEST WWTP	ROCKY BRANCH CREEK AND BAYOU METO FLOOD PLAIN	ROCKY BRANCH CREEK AND BAYOU METO SEDIMENTS
5. SHORT-TERM EFFECTIVENESS					
Community protection	Potential for migration of contaminated sediment or vapors into service lines and homes during cleaning of sewer lines. This migration can be controlled by obstructing lateral connections and informing the community of safety precautions. Temporary increase in dust production during repair of sewer lines; can be mitigated by dust suppression measures.	Temporary increase in dust production during consolidation activities; can be mitigated by dust suppression measures.	None	Temporary increase in dust production during excavation and consolidation; can be mitigated by dust suppression measures.	Risk to community not increased by alternative implementation.
Worker protection	Protection against dermal contact and inhalation of dust and vapors required during cleaning and repair of sewer lines.	Protection against dermal contact and inhalation of dust and vapors required during sludge removal and consolidation.	No significant risk to workers.	Protection against dermal contact and inhalation of dust required during excavation and consolidation.	Not applicable
Environmental impacts	Incineration will meet emission standards.	No significant increase in environmental effects expected.	No significant increase in environmental effects expected.	Potential for increased contaminant migration with dust or stormwater runoff during excavation.	Existing impacts not changed
Time until action is completed (After ROD is signed)	3 to 5 years (overall alternative)	3 to 5 years (overall alternative)	3 to 5 years (overall alternative)	3 to 5 years (overall alternative)	Not applicable.
6. IMPLEMENTABILITY					
Technical feasibility	Sewer line cleaning and repair are straightforward operations. Effectiveness determined by subsequent sampling and camera inspection. Easy to implement additional cleaning if needed.	Sludge removal and consolidation (with cap) is straightforward. Effectiveness determined by subsequent sampling. Easy to implement additional cleaning if needed. Consolidation cap requires periodic maintenance.	Fences are simple to construct.	Soil excavation and consolidation (with cap) is straightforward to operate and construct. Easy to implement additional excavation if needed. Consolidation cap requires periodic maintenance.	Technically feasible.
Administrative feasibility	NPDES permit not required for wastewater treatment plant effluent discharge to surface water. Must coordinate with Jacksonville wastewater authority regarding connection to new WWTP. Must coordinate with state air quality agency regarding incinerator emissions. Must show that incineration satisfies RCRA requirements in 40 CFR 264.340-264.351.	NPDES permit not required for wastewater treatment plant effluent discharge to surface water. Must coordinate with city of Jacksonville to restrict use of sludge drying beds.	Must coordinate with Jacksonville wastewater authority and Hercules Inc. regarding closeout of West WWTP.	Must coordinate with city of Jacksonville to impose deed/use restrictions on undeveloped residential flood plain areas.	Administratively feasible
Availability of services and materials	Sewer cleaning and repairing equipment is readily available. Wastewater treatment equipment is available. Mobile incinerators and filter presses exist; availability depends on current demand. Trained operators are required for incineration, dewatering, and wastewater treatment.	Equipment is readily available.	Equipment is readily available.	Equipment is readily available. Material for consolidation cap should be available locally.	Services and materials available

7. COST

Capital cost	3,900,000
Annual O&M cost	(first year) 35,000 (after first year) 33,000
30 year present value cost (5% discount rate)	4,000,000

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TABLE 5-3 (continued)

INDIVIDUAL ANALYSIS OF ALTERNATIVE 2

Vertac Off-Site FS
Jacksonville, Arkansas

Alternative 2 would not address the potential exposure to contaminated soil surrounding the active sewer lines or in and around the abandoned Rocky Branch Creek interceptor. Although there is currently no route for exposure to this material, it could be uncovered during sewer line repairs. Alternative 2 also would not control potential migration of contaminated soil that surrounds the active sewer lines (e.g., following infiltration), soil in the sludge-drying beds, sediment in the aeration basin or oxidation ponds, or soil that is not removed from the Rocky Branch Creek flood plain.

Alternative 2--Compliance with ARARs. Alternative 2 addresses contamination in the active collection lines, sludge digester, and Rocky Branch Creek flood plain soils to the level recommended by ATSDR. Sediments from the active collection lines, which have high (>200 ppb) concentrations of TCDD would be incinerated. RCRA hazardous waste management requirements would be applicable for the removal and treatment of these wastes. These requirements would be met under Alternative 2. RCRA management requirements are also applicable, and would be met, for the removal and consolidation of the digester sludges and flood plain soils.

Onsite consolidation of site wastes in previously contaminated areas of the site is allowed on Superfund sites. The intent is to allow consolidation of some areas of contamination, with capping of combined site wastes in one central area. The RCRA capping requirements (but not the landfilling requirements, such as for liners and leachate collection) are relevant and may be appropriate, depending on concentration, to this action. (See Appendix C for requirements for capping, consolidation, operation and maintenance, and surface water control.)

Solids dewatering prepares solid wastes for disposal in the onsite incinerator, or by consolidation. The RCRA hazardous waste management requirements are relevant and appropriate to the dewatering process and management of residuals. (See Table C-1 for RCRA requirements for container storage, tank storage, and treatment.)

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Onsite incineration would treat (destroy) dioxin in contaminated materials, and would satisfy RCRA hazardous waste disposal requirements. (See Table C-1 for RCRA requirements for incineration, treatment, and tank storage.)

The flushing water from collection lines, liquid from solids dewatering, liquid decontamination wastes, and scrubber blowdown water from incineration would be treated by an onsite filtration and carbon adsorption treatment system. Wastewater treatment standards for liquids contaminated by dioxin are not specified by RCRA. If the effluent of a wastewater treatment system is discharged to surface water, the requirements of the Clean Water Act are applicable. If the discharge is off-site, the substantive requirements of the National Pollutant Discharge Elimination System (NPDES) would be met. Effluents regulated by the Clean Water Act are not hazardous wastes, by definition. The RCRA hazardous waste management requirements would be applicable to management of the residuals from the treatment process. (See Table C-1 for requirements for container storage, direct discharge of effluent, tank storage, and treatment.)

Alternative 2--Long-Term Effectiveness and Permanence. Under Alternative 2, the inherent hazard of the contaminated material at the site would remain with the exception of the risk associated with the sediment in the active collection lines and contaminated soil excavated during sewer line repairs. Those materials would be removed and incinerated. The long-term risk associated with the incinerator ash, sludge from the digester, and the Rocky Branch Creek flood plain soil with TCDD >5.0 ppb would be eliminated as long as those materials are contained in onsite consolidation. Consolidation would require periodic maintenance of the RCRA cap covering the consolidated materials. The security of containment would be ensured by maintaining a healthy vegetative cover over the cap and repairing any erosion damage.

The fencing and institutional controls designed to restrict access and use of the Old STP grounds (especially the sludge-drying beds), the West WWTP facilities, and undeveloped residential areas of the Rocky Branch Creek flood plain with TCDD between 1.0 and 5.0 ppb are of limited effectiveness and reliability. To maximize their effectiveness, the fences would have to be maintained and the use restrictions enforced. Signs warning the public of potential hazards would need maintenance and periodic replacement. Periodic site review would be required to monitor the remedy, and a public information program would be necessary.

The risk associated with contaminated soil that surrounds the active sewer lines and with sediment/soil in and around the abandoned Rocky Branch Creek interceptor would not be addressed by Alternative 2.

The long-term effectiveness of the remedy for Rocky Branch Creek and Bayou Meto sediments is directly dependent on natural attenuation and the effectiveness of the fish advisory. Fish and wildlife monitoring will assess the continued need for the fish advisory.

Alternative 2--Reduction of Toxicity, Mobility, or Volume Through Treatment. In this alternative, incineration would destroy and thus reduce toxicity, mobility of volume (TMV) of 99.9999 percent of the TCDD in 10 cubic yards of sediment from the active sewer lines and an estimated 250 cubic yards of soil removed from around sewer lines during repairs. Incineration is an irreversible process, as is wastewater treatment by filtration and carbon adsorption coupled with incineration of filter solids and spent carbon. This wastewater treatment process is used to treat collection line flushing water, solids dewatering filtrate, and liquid decontamination waste. Under Alternative 2, TMV would not be reduced for the following materials:

- Potentially contaminated soil surrounding the active sewer lines

- Material in and around the abandoned Rocky Branch Creek interceptor
- Contaminated soil, sludge, and sediment at the Old STP
- Contaminated sediment in the aeration basin of the West WWTP
- Contaminated soil in the Rocky Branch Creek flood plain

Alternative 2--Short-Term Effectiveness. A temporary increase in risk to the community and workers would result from increased releases of contaminated dust during soil excavation, consolidation and capping, and sewer line repairs. Dust suppression measures (such as water or foam sprays and plastic membranes) would be used to mitigate release. Workers would wear protection against dermal contact and inhalation of dust and vapors while conducting remedial activities.

Alternative 2 involves a slight potential for the migration of contaminated sediment, water, or vapors into service lines during hydraulic cleaning of collection lines. However, this migration is unlikely since the cleaning procedure is designed to flush sediments downstream in the pipe being cleaned and no flow is directed into lateral lines. The flushing water is removed during the operation so water does not accumulate in the pipes. Also, most service lines should have traps designed to trap and vent materials moving upstream in those pipes. Nevertheless, the operation would be continuously monitored and, if necessary, obstructions would be placed in service lines to prevent migration of hazardous materials. The public would also be informed of the cleaning operation and of appropriate safety measures. Incinerator emissions would be limited to safe levels as determined by EPA, the State of Arkansas, and ATSDR.

It would take approximately 3 to 5 years after a Record of Decision is signed to complete all phases of remediation for Alternative 2.

Alternative 2--Implementability. Construction and operation of the components of Alternative 2 are straightforward. Equipment required for onsite incineration, solids dewatering, and wastewater treatment is generally available from equipment suppliers. The availability of specific mobile incinerators and dewatering units will depend on the demand at any particular time. Implementability of incineration is greatly enhanced if the system currently being constructed for onsite wastes can be used. Equipment vendors typically provide technicians trained in the startup and operation of these processes. The materials required for the RCRA cap and for backfilling excavated areas are assumed to be available locally. Subsequent sampling could be employed to monitor the effectiveness of the remedial actions, which could easily be expanded if necessary.

Implementation of Alternative 2 would require coordination with several agencies and groups:

- The closeout of the West WWTP would require coordination with Hercules Inc. and the Jacksonville Wastewater Authority, as would cleaning of the sewage collection lines and connection to the new WWTP.

- The City of Jacksonville would have to be petitioned for zoning changes and/or deed and use restrictions of undeveloped residential areas of the Rocky Branch Creek flood plain and the sludge-drying beds.

- Incineration would require the approval of the state air quality agency.

Alternative 2--Cost. A detailed cost estimate spreadsheet for Alternative 2 is presented in Appendix D. The estimated costs for Alternative 2 are:

- Capital cost = $3,900,000
- Annual O&M costs = $35,000 (first year), $33,000 (after first year)
- 30-year present-value cost (at a 5 percent discount rate) = $4,000,000

ALTERNATIVE 3

Table 5-4 summarizes the analysis of Alternative 3.

Alternative 3--Overall Protectiveness. Implementation of Alternative 3 would eliminate the risk of exposure to or migration of contaminated sediment in the active sewer lines, sludge in the digester, and soil in the drying beds, as well as Rocky Branch Creek flood plain soil containing more than 5.0 ppb TCDD. These materials would be incinerated, with the exception of soil from the sludge-drying beds, which would be covered with an asphalt-concrete cap. The risk of exposure or migration associated with contaminated soil surrounding the active sewer lines would be greatly reduced by lining the pipes and manholes. Installing pipe liners and repairing manholes would virtually eliminate infiltration of contaminated soil and water.

Fencing and institutional controls would reduce the risk of exposure to contaminated sediments in the Rocky Branch Creek flood plain (TCDD between 1.0 and 5.0 ppb), aeration basin, and oxidation ponds, but would not control the risk of contaminant migration from those areas.

Alternative 3--Compliance With ARARs. Alternative 3 has several components in common with Alternative 2. See Alternative 2 for discussions of ARARs compliance concerning:

- Removal of sediments from collection lines
- Removal of sludge from the digestor
- Removal of soils from Rocky Branch Creek
- Solids dewatering
- Onsite incineration
- Wastewater treatment and discharge to stream

EVALUATION CRITERIA	COLLECTION LINES	OLD STP	WEST WWTP	ROCKY BRANCH CREEK AND BAYOU METO FLOOD PLAIN	ROCKY BRANCH CREEK AND BAYOU METO SEDIMENTS
	Hydraulically clean active lines and incinerate sediments. Install pipe liners.	Remove sludge from digester and incinerate dewatered solids. Cover sludge drying beds with asphalt cap. Fence grounds and post signs.	Protect aeration basin and oxidation ponds from inundation during a 100-year flood by berming. Fence facilities and post signs.	Remove and incinerate soil with TCDD > 5.0 ppb from undeveloped residential areas. Restrict land use of undeveloped residential areas with TCDD between 1.0 and 5.0 ppb.	No further action. Continued advisory against ingestion of fish from affected areas. Continue fish and wildlife monitoring.
1. OVERALL PROTECTION					
Protection of human health	Eliminates the risk of exposure to contaminated sediments in the active collection lines. Reduces the potential for exposure to contaminated soil surrounding the lines by installing pipe liners and thereby reducing the need for repairs.	Eliminates the risk of exposure to contaminated material in the digester and sludge drying beds and the risk of agricultural use of the drying beds. Reduces the risk of exposure to contamination in the primary clarifiers and other facilities by fencing.	Reduces the risk of exposure to contaminated sediments in the aeration basin and oxidation ponds by fencing.	Reduces the risk of exposure/ingestion of contaminated soil remaining in undeveloped areas by removal of the more highly contaminated (TCDD > 5.0 ppb) sections and use restrictions on areas with TCDD between 1.0 and 5.0 ppb.	Proctective of human health as determined by EPA and ATSDR
Environmental protection	Eliminates the potential for migration of contaminated sediments in the collection lines, and the potential for infiltration of contaminated soil surrounding the pipes and subsequent migration.	Eliminates the potential for migration of contaminated soil from the drying beds.	Eliminates the potential for migration of contaminated sediments from the aeration basin and oxidation ponds during flooding ($\leq$ 100-year flood.)	Reduces the potential for migration of contaminated flood plain soils by removing the more highly contaminated (TCDD > 5.0 ppb) sections.	Continued fish and wildlife monitoring to address environmental effects.
2. COMPLIANCE WITH ARARs	Meets ATSDR recommendations. RCRA requirements met for management of sediments removed from active line.	Meets ATSDR recommendations. RCRA requirements for management of sludge removed from digester are met.	RCRA hazardous waste management requirements are relevant but not appropriate. ATSDR recommendations are met.	RCRA hazardous waste management requirements are applicable for management of excavated soils. These requirements will be met. Does not meet ATSDR recommendations for soils between 1.0 and 5.0 ppb.	Complies with EPA and ATSDR action level recommendations
3. LONG-TERM EFFECTIVENESS AND PERMANENCE					
Magnitude of residual risk	Eliminates risk associated with contaminated sediments within the active sewer lines. Reduces the risk of infiltration of contaminated soil into sewer lines. Does not reduce the risk associated with contaminated soil in and around abandoned interceptor and remaining outside active lines.	Eliminates risk associated with contaminated sludge in digester. Eliminates risk associated with sludge drying beds as long as cap is maintained, although inherent hazard of waste remains. Does not reduce risk associated with material in other facilities except by restricting access.	Eliminates risk of contaminent migration from aeration basin and oxidation ponds during flooding us to the 100-year flood. Inherent hazard of waste remains.	Eliminates risk associated with flood plain soil with TCDD >5.0 ppb. Does not reduce risk associated with contaminated soil (1.0 ppb < TCDD <5.0 ppb) left in place.	Fish advisory will reduce human health risks
Adequacy and reliability of controls	Incinerator ash disposed of in off-site RCRA landfill. No controls over contaminated soil surrounding active sewer lines or material in and around abandoned interceptor. Incineration reliably destroys TCDD-contaminated sediments from the active sewer lines.	Incinerator ash disposed of in RCRA landfill. Asphalt cap reliably controls contaminated soil in sludge drying beds, if maintained. Incineration reliably destroys TCDD-contaminated sludge from digester. Fencing and institutional controls designed to restrict access and use of STP facilities are of limited effectiveness and reliability.	Berms control migration of contaminated sediments in aeration basin and oxidation ponds during flooding. Berms would require some maintenance following flood events. Fencing and institutional controls designed to restrict access and use of WWTP facilities are of limited effectiveness and reliability.	Incinerator ash disposed of in RCRA landfill. Incineration reliably destroys TCDD-contaminated, soil removed from flood plain. Institutional controls designed to restrict access and use of contaminated areas are of limited effectiveness and reliability.	Not applicable
4. REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT					
Amount destroyed or treated	Destroys 99.9999% of TCDD in 10 cy of sediment from active sewer lines and 250 cy of soil excavated during repair of lines by incineration.	Destroys 99.9999% of TCDD in 890 cy of sludge from digester by incineration.	None	Destroys 99.9999% of TCDD in 400 cy of soil removed from flood plain by incineration.	None
Reduction of toxicity, mobility, or volume	Reduces volume of contaminated sediments in active sewer lines by 100% Reduces volume of contaminated material associated with repair of collection lines.	Reduces MTV of material with TCDD > 5.0 ppb by 100%. Reduces MTV of material with TCDD >1.0 ppb by 36%.	None	Reduces MTV of soil with TCDD > 5.0 ppb by 100%.	None
Irreversibility of treatment	Incineration is irreversible. Wastewater treatment by filtration/carbon adsorption with incineration of filter solids and spent carbon is irreversible.	Incineration is irreversible. Wastewater treatment by filtration/carbon adsorption with incineration of filter solids and spent carbon is irreversible.	None	Incineration is irreversible.	Not applicable.
Type and quantity of residuals remaining after treatment	Ash from incineration of 260 cy of soil/sediment remains.	Ash from incineration of 890 cy of sludge remains.	None	Ash from incineration of 400 cy of soil remains.	Not applicable.

TABLE 5-4

INDIVIDUAL ANALYSIS OF ALTERNATIVE 3

Vertac Off-Site FS
Jacksonville, Arkansas

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EVALUATION CRITERIA	COLLECTION LINES	OLD STP	WEST WWTP	ROCKY BRANCH CREEK AND BAYOU METO FLOOD PLAIN	ROCKY BRANCH CREEK AND BAYOU METO SEDIMENTS
5. SHORT-TERM EFFECTIVENESS					
Community protection	Potential for migration of contaminated sediment or vapors into service lines and homes during cleaning of sewer lines. This can be controlled by obstructing lateral connections and informing the community of safety precautions. Temporary increase in dust production during repair of sewer lines; can be mitigated by dust suppression measures.	Temporary increase in dust production during cap construction; can be mitigated by dust suppression measures.	Temporary increase in dust production during berm construction; can be mitigated by dust suppression measures.	Temporary increase in dust production during excavation; can be mitigated by dust suppression measures.	Risk to community not increased by alternative implementation.
Worker protection	Protection against dermal contact and inhalation of dust and vapors required during cleaning and repair of sewer lines.	Protection against dermal contact and inhalation of dust and vapor required during, sludge removal, soil capping, and incineration.	No significant risk to workers.	Protection against dermal contact and inhalation of dust required during excavation and incineration.	Not applicable
Environmental impacts	Incineration will meet emission standards.	Incineration will meet emission standards.	No significant increase in environmental effects expected.	Potential for increased contaminant migration with dust or stormwater runoff during excavation. Incineration may affect air quality but will meet emission standards.	Existing impacts not changed.
Time until action is completed (After ROD is signed)	3 to 4 years (overall alternative)	3 to 4 years (overall alternative)	3 to 4 years (overall alternative)	3 to 4 years (overall alternative)	Not applicable.
6. IMPLEMENTABILITY					
Technical feasibility	Sewer line cleaning and repair are straightforward operations. Effectiveness determined by subsequent sampling and camera inspection. Easy to implement additional cleaning if needed.	Sludge removal and the asphalt cap are straightforward to operate and construct. Effectiveness determined by subsequent sampling. Easy to implement additional cleaning if needed. Incineration is difficult to operate.	Flood control berms are straightforward to design and construct. Berms require maintenance after flooding.	Soil excavation is straightforward operation. Easy to implement additional excavation if needed. Incineration is difficult to operate.	Technically feasible.
Administrative feasibility	NPDES permit not required for wastewater treatment plant effluent discharge to surface water. Must coordinate with Jacksonville wastewater authority regarding connection to new WWTP. Must coordinate with state air quality agency regarding incinerator emissions. Must show that incineration satisfies RCRA requirements in 40 CFR 264.340-264.351. Must coordinate with RCRA landfill authorities regarding disposal of incinerator ash.	NPDES permit not required for wastewater treatment plant effluent discharge to surface water. Must coordinate with state air quality agency regarding incinerator emissions. Must demonstrate that incineration satisfies RCRA requirements in 40 CFR 264.340-264.351. Must coordinate with RCRA landfill authorities regarding disposal of incinerator ash.	Must coordinate with Jacksonville wastewater authority and Hercules Inc. regarding closeout of West WWTP. U.S. Army COE section 404 permit required for construction in a flood plain.	Must coordinate with city of Jacksonville to impose deed/use restrictions on undeveloped residential flood plain areas. Must coordinate with state air quality agency regarding incinerator emissions. Must show that incineration satisfies RCRA requirements in 40 CFR 264.340-264.351. Must coordinate with RCRA landfill authorities regarding disposal of incinerator ash.	Administratively feasible
Availability of services and materials	Sewer cleaning and repairing equipment is readily available. Wastewater treatment equipment is available. Mobile incinerators and filter presses exist; availability depends on current demand. Trained operators are required for incineration, dewatering, and wastewater treatment. RCRA landfills are available within 500 miles from the site for disposal of incinerator ash. Materials available for onsite disposal.	Asphalt-concrete cap material is readily available. Wastewater treatment equipment is available. Mobile incinerators and filter presses exist; availability depends on current demand. Trained operators are required for incineration, dewatering, and wastewater treatment. RCRA landfills are available within 500 miles from the site for disposal of incinerator ash. Materials available for onsite disposal.	Equipment is readily available. Material for berms should be available locally, but large quanity needed may be difficult to obtain.	Excavation equipment is readily available. Wastewater treatment equipment is available. Mobile incinerators exist; availability depends on current demand. Trained operators are required for incineration, dewatering, and wastewater treatment. RCRA landfills are available within 500 miles from the site for disposal of incinerator ash. Materials available for onsite disposal.	Services and materials available
7. COST					
Capital cost	7,600,000				
Annual O&M cost	(first year) 61,000 (after first year) 45,000 (additional every 5th year) 10,000				
30 year present value cost (5% discount rate)	8,000,000				

TABLE 5-4 (continued)

INDIVIDUAL ANALYSIS OF ALTERNATIVE 3

Vertac Off-Site FS
Jacksonville, Arkansas

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For the active collection lines, adding a resin liner would not change the ARARs evaluation given for Alternative 2.

Manifesting requirements for shipment of hazardous wastes would be applicable, as would all packaging, labeling, and handling requirements. (See Table C-1 for requirements for container storage and transportation of hazardous wastes.)

Alternative 3--Long-Term Effectiveness and Permanence. Alternative 3 would eliminate, via incineration, TCDD associated with the contaminated sediments in the collection lines, sludge in the digester, and soil with TCDD >5.0 ppb in the Rocky Branch Creek flood plain. Incineration reliably destroys TCDD (destroys 99.9999 percent). The incineration ash would be placed in a RCRA landfill.

The risk of infiltration of contaminated soil surrounding the collection lines would be reduced by lining pipes. The risk of exposure and agricultural use of the sludge-drying beds would be eliminated by capping, although TCDD would remain. The asphalt-concrete cap would require periodic maintenance (such as sealing cracks that develop). The oxidation ponds would be protected against inundation (and concomitant contaminant transport) during floods by berming. With proper maintenance of a vegetative cover and repair of any erosion damage after flooding, berms are a reliable flood control mechanism.

The fencing and institutional controls designed to restrict access and use of the Old STP, West WWTP, and contaminated flood plain areas would require maintenance and enforcement to be effective. The long-term effectiveness for the creek and bayou sediments is the same as Alternative 2.

Alternative 3 does not address the risk associated with contaminated soil surrounding the abandoned Rocky Branch Creek interceptor.

Alternative 3--Reduction of Toxicity, Mobility, or Volume Through Treatment. Under Alternative 3, 99.9999 percent of TCDD would be destroyed by incineration in approximately:

- 10 cubic yards of active sewer line sediment
- 250 cubic yards of soil surrounding the active sewer lines (removed during repair)
- 890 cubic yards of sludge from the digester
- 400 cubic yards of Rocky Branch Creek flood plain soil

Incineration is irreversible. The ash produced by incinerating these materials would be disposed of in either an off-site or onsite RCRA landfill (presuming the treatment standard of TCDD <1.0 ppb is met).

Wastewater from hydraulic cleaning of sewer lines, decontamination, and dewatering would be treated by filtration and carbon adsorption. The residual filter solids and spent carbon from this process would be incinerated. Wastewater treatment also is irreversible.

Alternative 3--Short-Term Effectiveness. The potential risks to the community, workers, and environment from implementation of Alternative 3 and the mitigative measures that would be employed are the same as described for Alternative 2.

It would take approximately 3 to 4 years after a Record of Decision is signed to complete all phases of remediation for Alternative 3.

Alternative 3--Implementability. The construction and operation of the components of Alternative 3 are straightforward. There are vendors that supply equipment and experienced operators for the mobile incineration, solids dewatering, and wastewater treatment processes. All other components of the alternative involve frequently employed, established procedures. The materials needed for capping, berming, and backfilling are assumed to be readily available although the large amount of soil required for berm construction may be difficult to obtain locally. RCRA landfills within 500 miles of the site are available for the disposal of incinerator ash if the off-site landfilling is selected.

Implementation of Alternative 3 would necessitate coordination with the agencies and groups listed under Alternative 2. In addition, a U.S. Army Corps of Engineers permit would be required for constructing berms around the oxidation ponds and for any other construction in the flood plain. Also, arrangements would have to be made with the authorities of a RCRA landfill to dispose of incinerator ash.

Alternative 3--Cost. A detailed cost estimate spreadsheet for Alternative 3 is presented in Appendix D. The estimated costs for Alternative 3 are:

- Capital cost = $7,600,000
- Annual O&M costs = $61,000 (first year), $45,000 (after first year), Additional $10,000 every fifth year
- 30-year present-value cost (at a 5 percent discount rate) = $8,000,000

ALTERNATIVE 4

Table 5-5 summarizes the analysis of Alternative 4.

Alternative 4--Overall Protectiveness. Alternative 4 would eliminate, by incineration, the risk of exposure or migration of contaminated sediment in the active sewer lines, sediment/soil in and around the abandoned Rocky Branch Creek interceptor, sludge in the digester, and soil in the drying beds, as well as Rocky Branch Creek and Bayou Meto flood plain soil with TCDD concentrations greater than 1.0 ppb.

The contaminated soil surrounding the active sewer lines would remain in place, but the risk of exposure or migration would be reduced by installing pipe liners. Lining the pipes would mitigate infiltration and add structural integrity, thereby reducing the need for future repairs.

The risk of migration of contaminated sediments from the aeration basin and oxidation ponds would be reduced by capping and berming, respectively. Fencing and institutional controls would also restrict access to the treatment plants.

Alternative 4--Compliance With ARARs. Alternative 4 has a number of components in common with Alternatives 2 and 3. See Alternative 2 for discussions of ARARs compliance for:

- Removal of sediments from the collection lines
- Sludge removal from digester
- Removal of soils >5.0 ppb from Rocky Branch Creek flood plain
- Solids dewatering
- Onsite incineration
- Wastewater treatment and discharge to stream

See Alternative 3 for discussions of ARARs compliance for ash disposal.

EVALUATION CRITERIA	COLLECTION LINES	OLD STP	WEST WWTP	ROCKY BRANCH CREEK AND BAYOU METO FLOOD PLAIN	ROCKY BRANCH CREEK AND BAYOU METO SEDIMENTS
	Hydraulically clean active lines and incinerate sediments. Install pipe liners. Remove abandoned Rocky Branch Interceptor.	Remove sludge from digester and soil from sludge drying beds and incinerate solids. Fence grounds and post signs.	Cover the dewatered dried aeration basin with a soil/vegetative cap. Protect oxidation ponds from inundation during a 100-year flood by berming. Fence facilities and post signs.	Remove and incinerate soil with TCDD >1.0 ppb from all residential areas.	No further action. Continued advisory against ingestion of fish from affected areas. Continue fish and wildlife monitoring.
1. OVERALL PROTECTIVENESS					
Human health protection	Eliminates the risk of exposure to contaminated sediment in the active and abandoned sewer lines and contaminated soil surrounding the abandoned interceptor. Reduces the potential for exposure to contaminated soil surrounding the active lines by installing pipe liners and thereby reducing the need for repair.	Eliminates the risk of exposure to contaminated material in the digester and sludge drying beds and the risk of agricultural use of the drying beds. Reduces the risk of exposure to contamination in the primary clarifiers and other facilities by fencing.	Reduces the risk of exposure to contaminated sediments in the aeration basin . Reduces the risk of exposure to contaminated sediments in the oxidation ponds by fencing.	Eliminates the risk of exposure/ingestion of soil with TCDD > 1.0 ppb.	Proctective of human health as determined by EPA and ATSDR
Environmental protection	Eliminates the potential for migration of contaminated sediments in the collection lines, and the potential for infiltration of contaminated soil surrounding the pipes and subsequent migration.	Eliminates the potential for migration of contaminated soil from the drying beds.	Eliminates the potential for migration of contaminated sediments from the aeration basin and from the oxidation ponds during flooding (≤ 100-year flood).	Eliminates the potential for migration of contaminated flood plain sediments with TCDD > 1.0 ppb.	Continued fish and wildlife monitoring to address environmental effects.
2. COMPLIANCE WITH ARARs	RCRA requirements for management of sediments and soils removed from the lines will be met. Meets ATSDR requirements.	RCRA hazardous waste management requirements for the sludge from the digester and drying beds will be met. Meets ATSDR recommendations.	RCRA hazardous waste management requirements are relevant but not appropriate. Meets ATSDR recommendations.	RCRA hazardous waste management requirements are applicable for management of excavated soils. These requirements will be met. Meets ATSDR recommendations.	Complies with EPA and ATSDR action level recommendations.
3. LONG-TERM EFFECTIVENESS AND PERMANENCE					
Magnitude of residual risk	Eliminates risk associated with contaminated sediments in the active sewer lines, the sediment in the abandoned interceptor, and the soil surrounding the abandoned interceptor. Reduces the risk of infiltration of contaminated soil into the active sewer lines. Does not reduce the risk associated with contaminated soil surrounding the active lines.	Eliminates risk associated with contaminated material in the sludge digester and sludge drying beds. Does not reduce risk associated with material in other facilities except by restricting access.	Eliminates risk associated with contaminated sediments in the aeration basin as ling as cap is maintained, although inherent hazard of waste remains. Eliminates risk of contaminant migration from oxidation ponds during flooding up to the 100-year flood; inherent hazard of waste remains.	Eliminates risk associated with flood plain soil with TCDD > 1.0 ppb.	Fish advisory will reduce human health risks
Adequacy and reliability of controls	Incinerator ash disposed of in RCRA landfill. No controls over contaminated soil surrounding active sewer lines. Incineration reliably destroys TCDD-contaminated sediment/soil from the active sewer lines and in and around the abandoned interceptor.	Incinerator ash disposed of in RCRA landfill. Incineration reliably destroys TCDD-contaminated sludge from digester and soil from drying beds. Institutional controls designed to restrict access and use of STP facilities are of limited effectiveness and reliability.	Soil/vegetative cap controls contaiminated sediments in aeration basin if maintained. Berms control migration of contaminated sediment from oxidation ponds during flooding. Berms would require some maintenance following flood events. Institutional controls designed to restrict access and use of WWTP facilities are of limited effectiveness and reliability.	Incinerator ash disposed of in RCRA landfill. Incineration reliably destroys TCDD-contaminated, soil removed from flood plain.	Not applicable
4. REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT					
Amount destroyed or treated	Destroys 99.9999% of TCDD in 10 cy of sediment from active sewer lines and 250 cy of soil excavated during repair of lines, and 3200 cy of material from removal of abandoned interceptor by incineration.	Destroys 99.9999% of TCDD in 890 cy of sludge from digester and 1500 cy of soil from drying beds by incineration.	None	Destroys 99.9999% of TCDD in 4,100 cy of soil removed from flood plain by incineration.	None
Reduction of toxicity, mobility, or volume	Reduces MTV of contaminated sediments in active sewer lines. Reduces MTV of contaminated material associated with collection lines.	Reduces MTV of material with TCDD > 1.0 ppb.	None	Reduces MTV of soil with TCDD > 1.0 ppb.	None
Irreversibility of treatment	Incineration is irreversible. Wastewater treatment by filtration/carbon adsorption with incineration of filter solids and spent carbon is irreversible.	Incineration is irreversible. Wastewater treatment by filtration/carbon adsorption with incineration of filter solids and spent carbon is irreversible.	None	Incineration is irreversible.	Not applicable.
Type and quantity of residuals remaining after treatment	Ash from incineration of 3,460 cy of soil/sediment/debris remains.	Ash from incineration of 2,390 cy of sludge remains.	None	Ash from incineration of 4,100 cy of soil remains.	Not applicable.

TABLE 5-5

INDIVIDUAL ANALYSIS OF ALTERNATIVE 4

Vertac Off-Site FS
Jacksonville, Arkansas

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EVALUATION CRITERIA	COLLECTION LINES	OLD STP	WEST WWTP	ROCKY BRANCH CREEK AND BAYOU METO FLOOD PLAIN	ROCKY BRANCH CREEK AND BAYOU METO SEDIMENTS
5. SHORT-TERM EFFECTIVENESS					
Community protection	Potential for migration of contaminated sediment or vapors into service lines and homes during cleaning of sewer lines. This can be controlled by obstructing lateral connections and informing the community of safety precautions. Temporary increase in dust production during repair and removal of sewer lines; can be mitigated by dust suppression measures.	Temporary increase in dust production during excavation; can be mitigated by dust suppression measures.	Temporary increase in dust production during berming and capping; can be mitigated by dust suppression measures.	Temporary increase in dust production during excavation; and consolodation; can be mitigated by dust suppression measures.	Risk to community not increased by alternative implementation.
Worker protection	Protection against dermal contact and inhalation of dust and vapors required during cleaning, repair, and removal of sewer lines.	Protection against dermal contact and inhalation of dust and vapors during soil excavation and incineration.	Protection against dermal contact and inhalation of dust required during draining, capping and berming	Protection against dermal contact and inhalation of dust required during excavation and incineration.	Not applicable
Environmental impacts	Incineration will meet emission standards. Potential for release of contaminated dust during excavation.	No significant increase in environmental effects expected. Potential for release of contaminatd dust during excavation. Incineration will meet emission standards.	Potential for increased contamionant migration with dust or wastewater during draining and capping of aeration basin Waterborne contaminates would migrate only to the oxidation ponds.	Potential for increased contamionant migration with dust or stormwater runoff during excavation. Incineration will meet emission standards.	Existing impacts not changed.
Time until action is completed completed	3 to 4 years (overall alternative)	3 to 4 years (overall alternative)	3 to 4 years (overall alternative)	3 to 4 years (overall alternative)	Not applicable.
6. IMPLEMENTABILITY					
Technical feasibility	Sewer line cleaning, repair, and removal are straightforward operations. Effectiveness determined by subsequent sampling and camera inspection. Easy to implement additional cleaning if needed.	Sludge and soil removal are straight-forward operations. Effectiveness is determined by subsequent sampling. Easy to implement additional cleaning or excavation if needed.	Berms and soil cap are straight-forward to design and construct. Both require periodic maintenance.	Soil excavation is straightforward operation. Easy to implement additional excavation if needed.	Technically feasible.
Administrative feasibility	NPDES permit not required for wastewater treatment plant effluent discharge to surface water. Must coordinate with Jacksonville wastewater authority regarding connection to new WWTP. Must coordinate with state air quality agency regarding incinerator emissions. Must show that incineration satisfies RCRA requirements in 40 CFR 264.340-264.351. Must coordinate with RCRA landfill authorities regarding disposal of incinerator ash.	NPDES permit not required for wastewater treatment plant effluent discharge to surface water. Must coordinate with state air quality agency regarding incinerator emissions. Must demonstrate that incineration satisfies RCRA requirements in 40 CFR 264.340-264.351. Must coordinate with RCRA landfill authorities regarding disposal of incinerator ash.	Must coordinate with Jacksonville wastewater authority and Hercules Inc. regarding closeout of west WWTP. U.S. Army COE section 404 permit required for construction in a flood plain. NPDES permit required for wastewater treatment plant effluent discharge to surface water.	Must coordinate with state air quality agency regarding incinerator emissions. Must show that incineration satisfies RCRA requirements in 40 CFR 264.340-264.351. Must coordinate with RCRA landfill authorities regarding disposal of incinerator ash.	Administratively feasible
Availability of services and materials	Sewer cleaning, grouting, and repairing equipment is readily available. Wastewater treatment equipment is available. Mobile incinerators and filter presses exist; availability depends on current demand. Trained operators are required for incineration, dewatering, and wastewater treatment. RCRA landfills are available within 500 miles from the site for disposal of incinerator ash. Materials available for onsite disposal.	Wastewater treatment equipment is available. Mobile incinerators and filter presses exist; availability depends on current demand. Trained operators are required for incineration, dewatering, and wastewater treatment. RCRA landfills are available within 500 miles from the site for disposal of incinerator ash. Materials available for onsite disposal.	Equipment is readily available. Material for berms and cap should be available locally, but the large quantity needed may be difficult to obtain.	Excavation equipment is readily available. Wastewater treatment equipment is available. Mobile incinerators exist; availability depends on current demand. Trained operators are required for incineration, dewatering, and wastewater treatment. RCRA landfills are available within 500 miles from the site for disposal of incinerator ash. Materials available for onsite disposal.	Services and materials available
7. COST					
Capital cost	20,000,000				
Annual O&M cost	(first year) 110,000 (after first year) 66,000				
30 year present value cost (5% discount rate)	21,000,000				

TABLE 5-5 (continued)

INDIVIDUAL ANALYSIS OF ALTERNATIVE 4

Vertac Off-Site FS,
Jacksonville, Arkansas

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RCRA hazardous waste management requirements are applicable to the removal and treatment of soils from Rocky Branch Creek flood plain. These requirements would be met in Alternative 4. Similarly, RCRA requirements are applicable, and would be met, for the management of sediments and sludges from the removal of the Rocky Branch Creek interceptor and sludge drying beds.

Alternative 4--Long-Term Effectiveness and Permanence. Under Alternative 4, the contaminated material in and around the abandoned Rocky Branch Creek interceptor and in the sludge-drying beds would be incinerated in addition to the media incinerated under Alternative 3. Rocky Branch Creek flood plain soil containing TCDD in excess of 1.0 ppb would also be removed and incinerated. The TCDD in the contaminated sediments in the aeration basin and oxidation ponds would remain, although the risk associated with those materials would be reduced. Capping the aeration basin would prevent exposure and migration. This cap would require maintenance of the vegetative layer and repair of erosional damage following flooding.

The flood protection berms around the oxidation ponds would mitigate migration of contaminated sediments. These berms would require maintenance similar to that required for the aeration basin cap. Other potentially contaminated materials remaining at the site would include soil surrounding the active sewer lines and the contents of the primary clarifiers.

The effectiveness of the remedy for the sediments of Rocky Branch Creek and Bayou Meto are the same as for Alternative 2.

Alternative 4--Reduction of Toxicity, Mobility, or Volume Through Treatment. In Alternative 4, a total of 9,400 cubic yards of TCDD-contaminated material would be incinerated. Incineration is irreversible. The incinerator ash would be disposed of in an off-site or onsite RCRA landfill. Treatment of wastewater from sewer line flushing, solids dewatering, and decontamination by filtration and carbon adsorption coupled with incineration of residues is irreversible.

Alternative 4--Short-Term Effectiveness. The potential for increased risks to the community, workers, and the environment during implementation of Alternative 4 would be essentially the same as for Alternative 3. The protective measures described earlier would also be appropriate for Alternative 4.

It would take approximately 3 to 4 years after a Record of Decision is signed to complete all phases of remediation for Alternative 4.

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Alternative 4--Implementability. Alternative 4, like the other alternatives, consists of frequently used and proven technologies. Hence, their design, construction, and operation are well established. The approvals and coordination with other agencies required for this alternative are the same as discussed previously for Alternatives 2 and 3. The equipment, expertise, materials, and services needed for this alternative are generally available. The large amount of soil required to cap the aeration basin and construct berms around the oxidation ponds may be difficult to obtain locally.

Alternative 4--Cost. A detailed cost estimate spreadsheet for Alternative 4 is presented in Appendix D. The estimated costs for Alternative 4 are:

- Capital cost = $20,000,000
- Annual O&M costs = $110,000 (first year), $66,000 (after first year)
- 30-year present-value cost (at a 5 percent discount rate) = $21,000,000

ALTERNATIVE 5

Table 5-6 summarizes the analysis of Alternative 5.

Alternative 5--Overall Protectiveness. Alternative 5 would eliminate the risk of exposure to or migration of all materials known to contain TCDD concentrations greater than 1.0 ppb. These materials would be removed and incinerated. In addition, Table 5-6 potentially contaminated soil (TCDD levels unknown) surrounding the active and abandoned sewer lines would be removed and incinerated, thereby precluding the possibility of future exposure to this material. Construction of new sewer lines should eliminate any chance of contaminating the new WWTP with TCDD. The oxidation ponds, which may contain TCDD levels of nearly 1.0 ppb (the highest 1988 sample contained 0.97 ppb TCDD), would be capped to prevent migration of its sediments.

Alternative 5--Compliance With ARARs. The ARARs considerations for most components of Alternative 5 are discussed under Alternatives 2, 3, and 4.

See Alternative 2 for discussion of ARARs compliance concerning:

- Removal of sludge from the digester
- Onsite incineration
- Solids dewatering
- Wastewater treatment and discharge to stream

See Alternative 4 for compliance discussions concerning excavating soil from the sludge-drying beds and the residential area.

The collection lines, sediments, and soils removed under Alternative 5 would be managed in accordance with RCRA hazardous waste management requirements.

The water and sediments in the primary clarifier are not classified as hazardous wastes. The presence of dioxin in the sediments makes RCRA hazardous waste management requirements relevant, but the low concentrations of dioxin probably are not sufficient to make the requirements appropriate. (See Table C-1 for requirements for container storage, excavation, tank storage, and waste piles.)

Water in the aeration basin and oxidation ponds would be expected to contain very low concentrations of dioxin. RCRA hazardous waste management requirements could be considered relevant to management of the water, but probably would not be considered appropriate. (See Appendix C for requirements for tank storage and container storage.) The water would be treated to meet substantive NPDES requirements.

Capping the oxidation ponds would further restrict potential human exposure to dioxin. The sediments in the ponds are not classified as hazardous wastes. The low concentration of dioxin in the oxidation pond sediments would make RCRA hazardous waste management requirements relevant, but not appropriate. (See Appendix C for requirements for capping, dike stabilization, and surface water control.)

Alternative 5--Long-Term Effectiveness and Permanence. All material shown by the sampling data to contain more than 1.0 ppb TCDD would be removed in Alternative 5. Therefore, the residual risk remaining at the site would be limited to the risks associated with exposure/migration of material with TCDD levels of less than 1.0 ppb.

Controls on remaining waste would include the caps on the oxidation ponds and the access and use restrictions for the Old STP, West WWTP, and Rocky Branch Creek and Bayou Meto. The soil/vegetation caps should reliably prevent migration of contaminated sediment from the oxidation ponds (provided the caps are maintained). The fencing and institutional controls would be of limited effectiveness and reliability in the

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EVALUATION CRITERIA	COLLECTION LINES	OLD STP	WEST WWTP	ROCKY BRANCH CREEK AND BAYOU METO FLOOD PLAIN	ROCKY BRANCH CREEK AND BAYOU METO SEDIMENTS
	Remove all sewer lies and incinerate soil, sediment, and debris. Construct new sewer lines.	Remove sludge from digester, soil from sludge drying beds, and sediment from primary clarifiers. Incinerate solids and treat wastewater. Fence grounds and post signs.	Remove sediments from aeration basin and incinerate solids. Cover dewatered, dried oxidation ponds with soil/vegetative cap. Treat wastewater Fence facilities and post signs.	Remove and incinerate soil with TCDD > 1.0 ppb.	No further action. Continued advisory against ingestion of fish from affected areas. Continue fish and wildlife monitoring.
1. OVERALL PROTECTIVENESS					
Protection of human health	Eliminates risk of exposure to contaminated material in and around the collection lines.	Eliminates the risk of exposure/use of contaminated material in the sludge digester, sludge drying beds, and primary clarifiers.	Eliminates the risk of exposure to contaminated sediments in the aeration basin and oxidation ponds.	Eliminates the risk of exposure/ingestion of soil with TCDD > 1.0 ppb.	Proctective of human health as determined by EPA and ATSDR
Environmental protection	Eliminates the potential for migration of contaminated material from in and around collection lines.	Eliminates the potential for migration of contaminated soil from the drying beds.	Eliminates the potential for migration from the aeration basin and oxidation ponds.	Eliminates the potential for migration of contaminated flood plain sediments with TCDD > 1.0 ppb.	Continued fish and wildlife monitoring to address environmental effects.
2. COMPLIANCE WITH ARARs	RCRA hazardous waste management requirements would be met for management of excavated material. Meets ATSDR recommendations.	RCRA hazardous waste management requirements will be met for material removed from old STP. Meets ATSDR recommendations.	RCRA hazardous waste management requirements are relevant but not appropriate. Meets ATSDR recommendations	RCRA hazardous waste management requirements are applicable to management of excavated soils. These requirements and ATSDR recommendations will be met.	Complies with EPA and ATSDR action level recommendations
3. LONG-TERM EFFECTIVENESS AND PERMANENCE					
Magnitude of residual risk	Eliminates risk associated with contaminated material in and around collection lines.	Eliminates risk associated with contaminated materal in the sludge digester, sludge drying beds, and primary clarifiers.	Eliminates risk associated with contaminated sediments in the aeration basin. Eliminates risk associated with contamintated sediments of the oxidation ponds as long as cap is maintained, although inherent hazard of waste remains.	Eliminates risk associated with flood plain soil with TCDD > 1.0 ppb.	Fish advisory will reduce human health risks
Adequacy and reliability of controls.	Incinerator ash disposed of in RCRA landfill. Incineration reliably destroys TCDD-contaminatd sediment/soil from in and around sewer lines.	Incerator ash disposed of in RCRA landfill. Incineration reliably destroys TCDD-contaminated sludge from digester, soil from drying beds, and sediment from primary clarifiers. Institutional controls designed to restrict access and use of STP facilities are of limited effectiveness and reliability.	Incinerator ash disposed of in RCRA landfill. Soil/vegetative cap controls contaminated sediments in oxidation ponds if maintained. Incineration reliably destroys TCDD-contaminated sediments from aeration basin.	Incinerator ash disposed of in RCRA landfill. Incineration reliably destroys TCDD-contaminated soil removed from flood plain.	Not applicable
4. REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT					
Amount destroyed or treated	Destroys 99.9999% of TCDD in 10,900 cy of material from removal of sewer lines by incineration.	Destroys 99.9999% of TCDD in 890 cy of sludge from digester, 1500 cy of soil from drying beds, and 90 cy of sediment from primary clarifiers by incineration. Treats 126,000 gal of wastewater from primary clarifiers by filtration/carbon adsorption.	Destroys 99.9999% of TCDD in 8000 cy of sediments from aeration basin by incineration. Treats 37 MG of wastewater from aeration basin and oxidation ponds by filtration/carbon adsorption.	Destroys 99.9999% of TCDD in 4,100 cy of soil removed from flood plain by incineration.	None
Reduction of toxicity, mobility, or volume	Reduces MTV of contaminated material associated with sewer lines by 100%.	Reduces MTV of material with TCDD > 1.0 ppb by 100%.	Reduces MTV of material with TCDD > 1.0 ppb by 100%.	Reduces MTV of soil with TCDD > 1.0 ppb by 100%.	None
Irreversibility of treatment	Incineration is irreversible. Wastewater treatment by filtration/carbon adsorbtion with incineration of filter solids and spent carbon is irreversible.	Incineration is irreversible. Wastewater treatment by filtration/carbon adsorbtion with incineration of filter solids and spent carbon is irreversible.	Incineration is irreversible. Wastewater treatment by filtration/carbon adsorbtion with incineration of filter solids and spent carbon is irreversible.	Incineration is irreversible.	Not applicable.
Type and quantity of residuals remaining after treatment	Ash from incineration of 10,900 cy of soil/sediment/debris remains.	Ash from incineration of 2,480 cy of soil/sludge/sediment remains.	Ash from incineration of 8,000 cy of sediment remains.	Ash from incineration of 4,100 cy of soil remains.	Not applicable.

TABLE 5-6

INDIVIDUAL ANALYSIS OF ALTERNATIVE 5

Vertac Off-Site FS
Jacksonville, Arkansas

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EVALUATION CRITERIA	COLLECTION LINES	OLD STP	WEST WWTP	ROCKY BRANCH CREEK AND BAYOU METO FLOOD PLAIN	ROCKY BRANCH CREEK AND BAYOU METO SEDIMENTS
5. SHORT-TERM EFFECTIVENESS					
Community protection	Temporary increase in dust production during removal of sewer lines; can be mitigated by dust suppression measures. New sewer lines must be constructed before removal of existing pipes.	Temporary increase in dust production during excavation; can be mitigated by dust suppression measures.	Temporary increase in dust production during berming and excavation; can be mitigated by dust suppression measures.	Temporary increase in dust production during excavation and consolidation; can be mitigated by dust suppression measures.	Risk to community not increased by alternative implementation.
Worker protection	Protection against dermal contact and inhalation of dust and vapors required during removal of sewer lines and during incineration.	Protection against dermal contact and inhalation of dust and vapors required during sludge removal, soil excavation, and incineration.	Protection against dermal contact and inhalation of dust required during draining, capping and excavation.	Protection against dermal contact and inhalation of dust required during excavation and incineration.	Not applicable
Environmental impacts	Potential for release of contaminated dust during excavation. Incineration will meet emission standards.	Incineration will meet emission standards. Potential for release of contaminated dust during excavation.	Potential for contaminant release to wastewater during dredging of aeration basin. Potential for increased contaminant migration with dust or wastewater during pumping and capping of oxidation ponds; however, all wastewater will be treated. Incineration will meet emission standards.	Potential for increased contaminant migration with dust or stormwater runoff during excavation. Incineration will meet emission standards.	Existing impacts not changed
Time until completion (After ROD is signed)	3 to 4 years (overall alternative)	3 to 4 years (overall alternative)	3 to 4 years (overall alternative)	3 to 4 years (overall alternative)	Not applicable.
6. IMPLEMENTABILITY					
Technical feasibility	Sewer line removal and construction are straightforward, but coordinating the two actions is difficult.	Sludge and soil removal are straightforward operations. Effectiveness is determined by subsequent sampling. Easy to implement additional cleaning or excavation if needed. Incineration is difficult to operate.	Sediment removal and cap construction are straight-forward. Cap requires periodic maintenance.	Soil excavation is straightforward operation. Easy to implement additional excavation if needed.	Technically feasible.
Administrative feasibility	NPDES permit not required for wastewater treatment plant effluent discharge to surface water. Must coordinate with Jacksonville wastewater authority regarding installation of new sewer lines and connection to new WWTP. Must coordinate with state air quality agency regarding incineration emissions. Must show that incineration satisfies RCRA requirements in 40 CFR 264.340-264.351. Must coordinate with RCRA landfill authorities regarding of disposal incdisposal inerator ash.	NPDES permit not required for wastewater treatment plant effluent discharge to surface water. Must coordinate with state air quality agency regarding incinerator emissions. Must show that incineration satisfies RCRA requirements in 40 CFR 264.340-264.351. Must coordinate with RCRA landfill authorities regarding disposal of incinerator ash.	Must coordinate with Jacksonville wastewater authority and Hercules Inc. regarding closeout of west WWTP. U.S. Army COE section 404 permit required for construction in a flood plain. NPDES permit not required for wastewater treatment plant effluent discharge to surface water. Must coordinate with state air quality agency regarding incinerator emissions. Must show that incineration satisfies RCRA requirements in 40 CFR 264.340-264.351. Must coordinate with RCRA landfill authorities regarding disposal of incinerator ash.	Must coordinate with state air quality agency regarding incinerator emissions. Must show that incineration satisfies RCRA requirements in 40 CFR 264.340-264.351. Must coordinate with RCRA landfill authorities regarding disposal of incinerator ash.	Administratively feasible
Availability of services and materials	Sewer removal and installation equipment is readily available. Wastewater treatment equipment is available. Mobile incinerators exist; availability depends on current demand. Trained operators are required for incineration, dewatering, and wastewater treatment. Materials available for onsite disposal.	Wastewater treatment equipment is available. Mobile incinerators and filter presses exist; availability depends on current demand. Trained operators are required for incineration, dewatering, and wastewater treatment. RCRA landfills are available within 500 miles from the site for disposal of incinerator ash. Materials available for onsite disposal.	Dredging and cap construction equipment is readily available. Material for cap should be available locally. Wastewater treatment equipment is available. Mobile incinerators and filter presses exist; availability depends on current demand. Trained operators are required for incineration, dewatering, and wastewater treatment.	Excavation equipment is readily available. Wastewater treatment equipment is available. Mobile incinerators exist; availability depends on current demand. Trained operators are required for incineration, dewatering, and wastewater treatment. RCRA landfills are available within 500 miles from the site for disposal of incinerator ash. Materials available for onsite disposal.	Services and materials available
7. COST					
Capital cost	38,000,000				
Annual O&M cost	(first year) 200,000 (after first year) 150,000				
30 year present value cost (5% discount rate)	40,000,0000				

TABLE 5-6 (continued)

INDIVIDUAL ANALYSIS OF ALTERNATIVE 5

Vertac Off-Site FS
Jacksonville, Arkansas

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future, but all materials with TCDD levels in excess of 1.0 ppb will have been removed from the Old STP and West WWTP. However, the remaining low levels of contaminants should not pose an unacceptable risk to public health.

The effectiveness of the remedy for the sediments of Rocky Branch Creek and Bayou Meto is the same as for Alternative 2.

Alternative 5--Reduction of Toxicity, Mobility, or Volume Through Treatment. Under Alternative 5, 22,000 cubic yards of TCDD-contaminated material would be incinerated. More than 37 million gallons of contaminated water currently at the site would be treated by filtration/carbon adsorption, as would wastewater generated by solids dewatering and decontamination of equipment. The filter solids and spent carbon from wastewater treatment would be incinerated. The wastewater treatment process and incineration are both irreversible. Incinerator ash would be landfilled off-site or onsite at a RCRA facility.

Alternative 5--Short-Term Effectiveness. The community, worker, and environmental protection considerations of Alternative 5 are virtually the same as for Alternatives 2, 3, and 4. The exception is that under Alternative 5 sewer lines would be removed rather than hydraulically cleaned; consequently, the risks associated with cleaning do not apply. Also, because more material would be removed and incinerated, the duration of risks associated with these actions (dust production, emissions) would be longer. Dust suppression measures and dermal and respiratory worker protection are important components of Alternatives 2 through 5.

It would take approximately 3 to 4 years after a Record of Decision is signed to complete all phases of remediation for Alternative 5.

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Alternative 5--Implementability. The actions involved in Alternative 5 are more extensive than in Alternatives 2, 3, and 4, but the technologies used are basically the same. Therefore, the technical and administrative feasibility and the availability of equipment, materials, and services would be as discussed for Alternatives 2, 3, and 4.

Alternative 5--Cost. A detailed cost estimate spreadsheet for Alternative 5 is presented in Appendix D. The estimated costs for Alternative 5 are:

- Capital cost = $38,000,000
- Annual O&M costs = $200,000 (first year), $150,000 (after first year)
- 30-year present-value cost (at a 5 percent discount rate) = $40,000,000

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ALTERNATIVES 6a AND 6b

Table 5-7 summarizes the evaluation of Alternatives 6a and 6b.

Alternatives 6a and 6b--Overall Protectiveness. Implementation of Alternative 6a or 6b would eliminate the risk of exposure or migration associated with contaminated sediments in the active collection lines, sludge in the digester, and Rocky Branch Creek flood plain soils containing greater than 1.0 ppb TCDD. Sediments removed from the active sewer lines, the sludge digester, and Rocky Branch Creek flood plain would be incinerated in Alternative 6a. Under Alternative 6b, soils excavated from Rocky Branch Creek would be consolidated onsite and capped. Both alternatives include the grouting of the abandoned Rocky Branch Creek interceptor line, which will minimize the potential for further contaminant migration in those lines. Demolition of the Old STP structures, burial onsite, and capping will reduce the potential for exposure to these contaminated materials.

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EVALUATION CRITERIA	COLLECTION LINES *Hydraulically clean active lines and incinerate sediments. Install pipe liners in active lines. Grout abandoned lines.*	OLD STP *Remove sludge from digester and incinerate dewatered solids. Cover sludge drying beds with 1 foot of clean soil. Demolish all structures, bury onsite, and cover with soil. Fence grounds and post signs.*	WEST WWTP *Dewater aeration basin. Cap basin. Place deed and use restrictions.*	ROCKY BRANCH CREEK AND BAYOU METO FLOOD PLAIN *Excavate and incinerate (6a) or consolidate onsite (6b) soil with TCDD>1.0 ppb.*	ROCKY BRANCH CREEK AND BAYOU METO SEDIMENTS *No further action. Continued advisory against ingestion of fish from affected areas. Continue fish and wildlife monitoring.*
1. OVERALL PROTECTIVENESS					
Human health protection	Eliminates the risk of exposure to contaminated sediments in the active collection lines. Reduces the potential for exposure to contaminated soil surrounding the lines by installing pipe liners and thereby reducing the need for repairs. *Grouting of abandoned lines reduces potential for further contaminent migration.*	Eliminates the risk of exposure to contaminated material in the digester and sludge drying beds and the risk of agricultural use of the drying beds. Reduces the risk of exposure to contamination in the primary clarifiers and other facilities by demolition, capping, and fencing.	Reduces the risk of exposure to contaminated sediments in the aeration basin and oxidation ponds by fencing.	Eliminates the risk of exposure/ingestion of soil with TCDD > 1.0 ppb.	Proctective of human health as determined by EPA and ATSDR
Environmental protection	Eliminates the potential for migration of contaminated sediments in the collection lines, and the potential for infiltration of contaminated soil surrounding the pipes and subsequent migration.	Eliminates the potential for migration of contaminated soil from the drying beds.	Eliminates the potential for migration of contaminated sediments from the aeration basin.	Eliminates the potential for migration of contaminated flood plain sediments with TCDD > 1.0 ppb.	Continued fish and wildlife monitoring to address environmental effects.
2. COMPLIANCE WITH ARARs	Meets ATSDR recommendations. RCRA requirements met for management of sediments removed from active line.	Meets ATSDR recommendations. RCRA requirements for management of sludge removed from digester are met.	RCRA hazardous waste management requirements are relevant but not appropriate. Meets ATSDR recommendations.	*All excavated soil will be managed per RCRA. Meets ATSDR recommendations.*	Complies with EPA and ATSDR *action level recommendations*
3. LONG-TERM EFFECTIVENESS AND PERMANENCE					
Magnitude of residual risk	Eliminates risk associated with contaminated sediments within the active sewer lines. Reduces the risk of infiltration of contaminated soil into sewer lines. Reduces potential for migration and exposure from abandoned line.	Eliminates risk associated with contaminated sludge in digester. Eliminates risk associated with sludge drying beds as long as cap is maintained, although inherent hazard of waste remains. Reduces risk due to exposure to contaminated structures by demolition, capping, and fencing.	Eliminates risk associated with contaminated sediments in the aeration basin as long as cap is maintained, although inherent hazard of waste remains. Risks from oxidation ponds are minimized using access restrictions.	Eliminates risk associated with flood plain soil with TCDD > 1.0 ppb.	Fish advisory will reduce human health risks
Adequacy and reliability of controls	Incinerator ash disposed of in RCRA landfill. No controls over contaminated soil surrounding active sewer lines or material in and around abandoned interceptor. Incineration reliably destroys TCDD-contaminated sediments from the active sewer lines.	Incinerator ash disposed of in RCRA landfill. Soil cap reliably controls contaminated soil in sludge drying beds, if maintained. *Incineration reliably destroys TCDD-contaminated sludge from digester.* Fencing and institutional controls designed to restrict access and use of STP facilities are of limited effectiveness and reliability.	Soil/vegetative cap controls contaiminated sediments in aeration basin if maintained. Institutional controls designed to restrict access and use of WWTP facilities are of limited effectiveness and reliability.	Incinerator ash disposed of in off-site RCRA landfill. Incineration reliably destroys TCDD-contaminated. soil removed from flood plain, for Alternative 6a. Cap would require controls under Alternative 6b.	Not applicable
4. REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT					
Amount destroyed or treated	Destroys 99.9999% of TCDD in 10 cy of sediment from active sewer lines and 250 cy of soil excavated during repair of lines by incineration.	Destroys 99.9999% of TCDD in 890 cy of sludge from digester by incineration.	None	Destroys 99.9999% of TCDD in 4100 cy of soil removed from flood plain by incineration in 6a. Alternative 6a does not destroy any soil.	None
Reduction of toxicity, mobility, or volume	Reduces MTV of contaminated sediments in active sewer lines by 100%. Reduces MTV of contaminated material associated with collection lines .	Reduces MTV of material with TCDD > 5.0 ppb by 100% Reduces MTV of material with TCDD >1.0 ppb..	None	Reduces MTV of soil with TCDD > 1.0 ppb by 1.00% in 6a. No reduction in volume for 6b.	None
Irreversibility of treatment	Incineration is irreversible. Wastewater treatment by filtration/carbon adsorption with incineration of filter solids and spent carbon is irreversible.	Incineration is irreversible. Wastewater treatment by filtration/carbon adsorption with incineration of filter solids and spent carbon is irreversible.	None	Incineration is irreversible.	Not applicable.
Type and quantity of residuals remaining after treatment	Ash from incineration of 250 cy of soil/sediment remains.	Ash from incineration of 890 cy of sludge remains.	None	Ash from incineration of 4100 cy of soil remains.	Not applicable.

TABLE 5-7

INDIVIDUAL ANALYSIS OF ALTERNATIVES 6a and 6b

Vertac Off-Site FS
Jacksonville, Arkansas

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EVALUATION CRITERIA	COLLECTION LINES	OLD STP	WEST WWTP	ROCKY BRANCH CREEK AND BAYOU METO FLOOD PLAIN	ROCKY BRANCH CREEK AND BAYOU METO SEDIMENTS
5. SHORT-TERM EFFECTIVENESS					
Community protection	Potential for migration of contaminated sediment or vapors into service lines and homes during cleaning of sewer lines. This can be controlled by obstructing lateral connections and informing the community of safety precautions. Temporary increase in dust production during repair and removal of sewer lines; can be mitigated by dust suppression measures.	Temporary increase in dust production during cap. construction; can be mitigated by dust suppression measures.	Temporary increase in dust production during berming and capping; can be mitigated by dust suppression measures.	Temporary increase in dust production; during excavation; can be mitigated by dust suppression measures.	Risk to community not increased by alternative implementation. Existing impacts not changed.
Worker protection	Protection against dermal contact and inhalation of dust and vapors required during cleaning, repair, and removal of sewer lines.	Protection against dermal contact and inhalation of dust and vapors required during, sludge removal, soil capping, and incineration.	No significant risk to workers.	Protection against dermal contact and inhalation of dust required during excavation and incineration.	Not applicable
Environmental impacts	Incineration will meet emission standards.	No significant increase in environmental effects expected.	No significant increase in environmental effects expected.	Potential for increased contamianant migration with dust or stormwater runoff during excavation. Incineration will meet emission standards.	
Time until action is completed completed	3 to 4 years (overall alternative)	3 to 4 years (overall alternative)	3 to 4 years (overall alternative)	3 to 4 years (overall alternative)	Not applicable.
6. IMPLEMENTABILITY					
Technical feasibility	Sewer line cleaning: grouting and repair are straightforward operations. Effectiveness determined by subsequent sampling and camera inspection. Easy to implement additional cleaning if needed. Incineration is a proven technology. Materials handling may be difficult.	Sludge and soil removal are straight-forward operations. Effectiveness is determined by subsequent sampling. Easy to implement additional cleaning or excavation if needed.	Draining aeration pond and capping are straightforward.	Soil excavation is straightforward operation. Easy to Easy to implement additional excavation if needed. Consolidation is straightforward.	Technically feasible.
Administrative feasibility	NPDES permit not required for wastewater treatment plant effluent discharge to surface water. Must coordinate with Jacksonville wastewater authority regarding connection to new WWTP. Must coordinate with state air quality agency regarding incinerator emissions. Must show that incineration satisfies RCRA requirements in 40 CFR 264.340-264.351. Must coordinate with RCRA landfill authorities regarding disposal of incinerator ash.	NPDES permit not required for wastewater treatment plant effluent discharge to surface water. Must coordinate with state air quality agency regarding incinerator emissions. Must demonstrate that incineration satisfies RCRA requirements in 40 CFR 264.340-264.351. Must coordinate with RCRA landfill authorities regarding disposal of incinerator ash.	Must coordinate with Jacksonville wastewater authority and Hercules Inc. regarding closeout of west WWTP. U.S. Army COE section 404 permit required for construction in a flood plain.	Must coordinate with city of Jacksonville to impose deed/use restrictions on undeveloped residential flood plain areas. Must coordinate with state air quality agency regarding incinerator emissions. Must show that incineration satisfies RCRA requirements in 40 CFR 264.340-264.351. Must coordinate with RCRA landfill authorities regarding disposal of incinerator ash.	Administratively feasible
Availability of services and materials	Sewer cleaning, grouting, and repairing equipment is readily available. Wastewater treatment equipment is available. Mobile incinerators and filter presses exist: availability depends on current demand. Trained operators are required for incineration, dewatering, and wastewater treatment. RCRA landfills are available within 500 miles from the site for disposal of incinerator ash. Materials are available for onsite disposal.	Soil cap material is readily available. Wastewater treatment equipment is available. Mobile incinerators and filter presses exist; availability depends on current demand.Incinerator currently being constructed for onsite use may be utilized. Trained operators are required for incineration. dewatering. and wastewater treatment. RCRA landfills are available within 500 miles from the site for disposal of incinerator ash. Materials are available for onsite disposal.	Equipment is readily available.	Excavation equipment is readily available. Wastewater treatment equipment is available. Mobile incinerators exist: availability depends on current demand. Trained operators are required for incineration, dewatering, and wastewater treatment. RCRA landfills are available within 500 miles from the site for disposal of incinerator ash. Materials are available for onsite disposal.	Services and materials available
7. COST					
Capital cost					
Annual O&M cost					
30 year present value cost (5% discount rate)					

TABLE 5-7 (continued)

INDIVIDUAL ANALYSIS OF ALTERNATIVE 6a and 6b

Vertac Off-Site FS
Jacksonville, Arkansas

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Alternatives 6a and 6b--Compliance with ARARs. Alternatives 6a and 6b have several components in common with the previous alternatives. See Alternative 2 for discussions of ARARs compliance for:

- Hydraulic flushing and liner installation in active collection lines
- Sludge removal from digester
- Access restrictions for the Old STP and West WWTP
- Solids dewatering
- Onsite incineration
- Wastewater treatment and discharge to stream

See Alternative 4 for a discussion of excavation from Rocky Branch Creek.

As discussed previously, RCRA hazardous waste management requirements are considered relevant to the contamination in and around the abandoned collection lines, but not appropriate. Therefore, although there is no ARAR requiring grouting, this remedy component provides a cost-effective means of minimizing further contaminant migration through the collection lines.

Onsite consolidation of site wastes in previously contaminated areas of the site is allowed on Superfund sites. The consolidation of the demolished Old STP structures would not require the RCRA capping requirement to be met due to the low TCDD levels.

Alternatives 6a and 6b--Long-Term Effectiveness and Permanence. Alternative 6a would eliminate, via incineration, the hazard associated with the contaminated sediments in the active collection lines, sludge in the digester, and soil with TCDD greater than 1.0 ppb in the Rocky Branch Creek flood plain. Incineration reliably destroys TCDD. Alternative 6b would not incinerate soils excavated from Rocky Branch Creek but instead would consolidate and cap these materials onsite. This would prevent direct exposure to contaminated soils and restrict any possible migration.

The risk of infiltration of contaminated soil surrounding the active collection lines would be reduced by lining the pipes.

The risk of further migration through the abandoned lines would be reduced by grouting the lines. However, the effectiveness of the grouting process is uncertain and cannot be measured because of the dilapidated nature of sections of the collection line.

The risk of exposure and agricultural use of the sludge-drying beds would be reduced by capping. The soil cap would require periodic maintenance. The demolition of the STP structure will eliminate potential exposures with these contaminated materials.

The fencing and institutional controls designed to restrict access and use of the Old STP and West WWTP would require maintenance and enforcement to be effective.

Flood plain soils would be excavated to 1 ppb TCDD, meeting the ATSDR level for residential use.

Alternatives 6a and 6b--Reduction of Toxicity, Mobility, or Volume Through Treatment. In Alternative 6a, a total of 4,650 cubic yards of TCDD-contaminated material would be incinerated. In Alternative 6b, 550 cubic yards of material would be incinerated. Incineration is irreversible. The incinerator ash would be disposed of in an off-site RCRA landfill. Treatment of wastewater from sewer line flushing, solids dewatering, and decontamination by filtration/carbon adsorption coupled with incineration of residues is irreversible.

Alternatives 6a and 6b--Short-Term Effectiveness. The potential for increased risks to the community, workers, and the environment during implementation of Alternatives 6a and 6b would be essentially the same as for Alternative 3. The protective measures described earlier would also be appropriate for Alternatives 6a and 6b.

It would take approximately 3 to 4 years after a Record of Decision is signed to complete all phases of remediation for Alternatives 6a and 6b.

Alternatives 6a and 6b--Implementability. Alternative 4, like the other alternatives, consists of frequently used and proven technologies. Hence, their design, construction, and operation are well established. The permits, approvals, and coordination with other agencies required for this alternative are the same as discussed previously for Alternatives 2 and 3. The equipment, expertise, materials, and services needed for this alternative are generally available. The large amount of soil required to cap the aeration basin and construct berms around the oxidation ponds may be difficult to obtain locally.

Alternatives 6a and 6b--Cost. A detailed cost estimate spreadsheet for Alternative 6a and 6b is presented in Appendix D. The estimated costs for Alternative 6a are:

- Capital cost = $13,400,000
- Annual O&M costs = $57,000 (first year), $46,000 (after first year)
- 30-year present-value cost (at a 5 percent discount rate) = $14,000,000

The estimated costs for Alternative 6b are:

- Capital cost = $10,400,000
- Annual O&M costs = $72,000 (first year), $46,000 (after first year)
- 30-year present-value cost (at a 5 percent discount rate) = $11,000,000

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COMPARATIVE ANALYSIS

The comparative analysis of alternatives considers the relative performance of each alternative with respect to the evaluation criteria. The purpose is to compare the relative strengths and weaknesses of the five alternatives so that key tradeoffs can be identified. The results of the comparative analysis are presented in Table 5-8.

EVALUATION CRITERIA	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4	ALTERNATIVE 5	ALTERNATIVE 6a and 6b
	NO ACTION	COLLECTION LINES: Hydraulically clean active lines and incinerate sediments. OLD STP: Remove sludge from digester and consolidate dewatered solids onsite. Fence grounds and post signs. WEST WWTP: Fence facilities and post signs. ROCKY BRANCH FLOOD PLAIN: *Remove soil with TCDD > 5.0 ppb* from undeveloped residential areas and consolidate it onsite. Restrict use of undeveloped residential areas with TCDD between 1.0 & 5.0 ppb. ROCKY BRANCH AND BAYOU METO SEDIMENTS: No action. Continue fish advisory and monitoring.	COLLECTION LINES: Hydraulically clean active lines and incinerate sediments. Install pipe liners. *OLD STP: Remove sludge from digester* and incinerate dewatered solids. Cover sludge-drying beds with asphalt cap. Fence grounds and post signs. WEST WWTP: Protect oxidation ponds from 100-year flood by berming. Fence facilities and post signs. ROCKY BRANCH FLOOD PLAIN: Remove previously excavated soil. Remove and and incinerate soil with TCDD > 5.0 ppb from undeveloped residential areas. Restrict use of undeveloped residential areas with TCDD between 1.0 & 5.0 ppb ROCKY BRANCH AND BAYOU METO SEDIMENTS: No action. Continue fish advisory and monitoring.	COLLECTION LINES: Hydraulically clean active lines and incinerate sediments. Install pipe liners. Remove abandoned Rocky Branch interceptor. OLD STP: Remove sludge from digester and soil from sludge drying beds and incinerate solids. Fence grounds and post signs. WEST WWTP: Cover dewatered, dried aeration basin with a soil/vegetative cap. *Protect oxidation ponds from a* 100-year flood by berming. Fence facilities and post signs. ROCKY BRANCH FLOOD PLAIN: Remove and incinerate soil with TCDD > 1.0 ppb from all residential areas. *ROCKY BRANCH AND BAYOU METO* SEDIMENTS: No action. Continue fish advisory and monitorir.g.	COLLECTION LINES: Remove all sewer lines and incinerate soil, sediment, and debris. Construct new sewer lines. OLD STP: Remove sludge from digester, soil from sludge drying beds, and sediment from primary clarifiers. Incinerate solids and treat wastewater. Fence grounds and post signs. WEST WWTP: Remove sediments from aeration basin and incinerate solids. *Cover dewatered, dryed oxidation ponds* with soil/vegetative cap. Treat wastewater. Fence facilitites and post signs. ROCKY BRANCH FLOOD PLAIN: Remove and incinerate soil with TCDD > 1.0 ppb. ROCKY BRANCH AND BAYOU METO SEDIMENTS: No action. Continue fish advisory and monitoring.	COLLECTION LINES: Hydraulically clean active lines and incinerate sediments. Install pipe liners. Grout abandoned lines. OLD STP: Remove sludge from digester, and incinerate dewatered sludge. Cover sludge-drying beds with soil cap. Demolish, bury, and cap OLD STP structures. Fence grounds and post signs. WEST WWTP: Cover dewatered, dried aeration basin with a soil cap. Fence *facilities and post signs.* ROCKY BRANCH FLOOD PLAIN: Excavate and incinerate (6a) or consolidate onsite (6b) soil with TCDD > 1.0 ppb. ROCKY BRANCH AND BAYOU METO SEDIMENTS: No action. Continue fish advisory and monitoring.
1. OVERALL PROTECTIVENESS						
Protection of Human Health	Does not reduce exposure/ingestion risks associated with contaminated materials in off-site area.	Eliminates risk of exposure to contaminated sediments in active sewer lines, sludge in digester, Rocky Branch flood plain soil with TCDD > 5.0 ppb. Least protective action alternative.	Eliminates human health risks as in Alternative 2, plus risk of exposure to contaminated soil in sludge drying beds. Reduces risk of exposure to soil surrounding active sewer lines.	Eliminates and reduces human health risks as in Alternative 3, plus exposure/ingestion risks associated with Rocky Branch flood plain soil with TCDD > 1.0 ppb, contaminated sediment in aeration basin, and contaminated material in and around abandoned Rocky Branch interceptor.	Eliminates human health risks as in Alternative 4, plus risk of exposure to contaminated soil associated with all sewerage collection lines and sediments in oxidation ponds. Most protective action alternative.	Eliminates human health risks as in Alt[illegible] 3, plus risk of exposure to contaminatec structures. Reduces migration and exposure through abandoned collection lines. Eliminates risks associated with Rocky Branch flood plain soil with TCDD > 1.0 ppb.
Environmental Protection	Does not reduce potential migration of contaminants.	Eliminates potential migration of contaminated sediment in active sewer lines, sludge in digester, Rocky Branch flood plain soil with TCDD > 5.0 ppb. Least protective action alternative	Eliminates environmental risks as in Alternative 2, plus potential migration of contaminated soil surrounding active sewer lines and soil in sludge drying beds. Reduces potential migration of contaminated sediments in oxidation ponds.	Eliminates environmental risks as in Alternative 3, plus potential migration of Rocky Branch flood plain soil with TCDD > 1.0 ppb and sediments in aeration basin. Reduces potential migration of contaminated sediment in oxidation ponds.	Eliminates environmental risks as in Alternative 4, plus potential migration of contaminated sediments in oxidation ponds. Most protective action alternative.	Eliminates environmental risks as in Alternative 3, plus potential migration from abandoned lines and Rocky Branch flood plain soil with TCDD greater than 1.0 ppb.
2. COMPLIANCE WITH ARARs	ATSDR recommendations are not met by the No Action alternative.	Collection line sediments, digester sludge, and excavated flood plain soils managed per RCRA. Meets ATSDR recommendations for collection lines, old STP, West WWTP. Does not meet ATSDR recommendations for flood plain soils between 1.0 & 5.0 ppb.	Same as Alternative 2.	Collection line pipe, sediments, and soils managed per RCRA. Digester sludge, drying bed sludge, and flood plain soils managed per RCRA. Meets ATSDR recommendations for all areas.	Same as Alternative 4.	Collection line sediments, digester sludge, and flood plain soils managed per RCRA. Meets ATSDR recommendations for all areas.
3. LONG-TERM EFFECTIVENESS AND PERMANENCE						
Magnitude of Residual Risk	Does not reduce potential migration of contaminants.	Does not reduce risks associated with these contaminated materials: • Soil surrounding sewage collection lines • *Soil in sludge-drying beds* • Sediment in primary clarifiers, aeration basin, and oxidation ponds • Rocky Branch flood plain soil with TCDD levels between 1.0 and 5.0 ppb Consolidating and capping reduces risks associated with contaminated sludge in digester and Rocky Branch flood plain soil with TCDD > 5.0 ppb, but TCDD remains. Has highest residual risk of the action alternatives.	Does not reduce risks associated with these contaminated materials: • Soil in and around abandoned Rocky Branch interceptor • Sediment in primary clarifiers • Rocky Branch flood plain soil with TCDD levels between 1.0 and 5.0 ppb Lining pipes reduces risk associated with contaminated soil surrounding active sewer lines. Capping reduces risk associated with contaminated soil in sludge drying beds. Berming reduces risks associated with contaminated sediments in oxidation ponds.	Does not reduce risk associated with contaminated sediment in primary clarifiers. Lining pipes reduces risk associated with contaminated soil surrounding active sewer lines. Capping reduces risks associated with contaminated sediments in aeration basin. Berming reduces risks of contaminated sediment in oxidation ponds.	Capping reduces risks associated with contaminated sediments in oxidation ponds, but inherent hazard of waste remains. Eliminates risk associated with all materials known or expected to be contaminated with TCDD > 1.0 ppb. Has lowest residual risk of all alternatives.	Demolition and capping of OLD STP treatment units reduces the potential to exposure from these units. Grouting reduces risk from migration through abandoned lines. Lining pipes reduces risk in active line. Capping reduces risk with sediments in aeration basin. Eliminates risk associated with all materials expected to be contaminated with TCDD > 1.0 ppb in flood plain.
Adequacy and Reliability of Controls	Not applicable	RCRA cap (if maintained) will reliably contain contaminated materials in onsite consolidation. Use and access restrictions have limited effectiveness and reliability.	Asphalt cap will reliably contain contaminated soil in sludge-drying beds and restrict its use. Flood-control berms will reliably prevent migration of contaminated sediments in oxidation ponds (for up to 100-year-flood flows). Both cap and berms will require maintenance. Use and access restrictions have limited *effectiveness and reliability.*	Soil/vegetative cap will reliably contain contaminated sediment in aeration basin. Flood-control berms will reliably prevent migration of contaminated sediments in oxidation ponds (for up to 100-year-flood flows). Both cap and berms will require maintenance. Effectiveness of use and access restrictions *is not essential because contaminated* material with TCDD > 1.0 ppb will be removed.	Soil/vegetative cap (if maintained) will reliably contain contaminated sediment in oxidation ponds. Effectiveness of use and access restrictions is not essential because contaminated material with TCDD > 1.0 ppb will be removed.	Soil cap will reliably contain contaminated sediment in aeration basin and OLD STP. Effectiveness of grouting is uncertain and difficult to measure.

TABLE 5-8
COMPARATIVE ANALYSIS OF ALTERNATIVES

Vertac Off-Site FS
Jacksonville, Arkansas

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EVALUATION CRITERIA	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4	ALTERNATIVE 5	ALTERNATIVE 6a and 6b
4. REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT						
Amount Destroyed or Treated	None	Incineration destroys 99.9999% of TCDD in: • 10 cy of sediment in active sewer lines • 250 cy of soil surrounding active sewer lines	Incineration destroy contamination as listed in Alternative 2, plus 99.9999% of TCDD in: • 890 cy of sludge in digester • 400 cy of Rocky Branch flood plain soil	Incineration destroys contamination as listed in Alternative 3, plus 99.9999% of TCDD in: • An additional 3,700 cy of contaminated Rocky Branch flood plain soil • 3,200 cy of material in and around abandoned Rocky Branch interceptor • 1,500 cy of soil in sludge drying beds	Incineration destroys contamination as listed in Alternative 4, plus 99.9999% of TCDD in: • 7,440 cy of material in and around active sewer lines. • 90 cy of sediment in primary clarifiers • 8,000 cy of sediment in aeration basin Treats 37 million gallons of contaminated wastewater from primary clarifiers, aeration basin, and oxidation ponds.	In Alternative 6a, incineration destroys: • 10 cy of sediment in active lines • 250 cy of soil surrounding active lines. • 890 cy of sludge in digester • 4100 cy of Rocky Branch flood plain soil
Reduction of Toxicity, Mobility, or Volume	None	Reduces MTV of sediments in collection lines. Reduces mobility of digester sludge and *flood plain soils <5.0 ppb.*	Reduces MTV of digester sludge, collection line sediments, and flood plain soils through *incineration.*	Reduces MTV of collection line pipe, soils and sediment, digester and drying bed sludge, *and flood plain soils through incineration.*	Same as Alternative 4, plus MTV reduced for active line, primary clarifiers, and aeration basin through *incineration.*	MTV reduced in Alternative 6a using incineration for collection line sediments and soils, digester sludge, and flood plain soils. In Alternative 6b, mobility is reduced for flood plain soils through onsite consolidation.
Irreversibility of Treatment	Not applicable	Incineration is irreversible. Wastewater treatment coupled with incineration of residues is irreversible.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Type and Quantity of Residuals *Remaining After Treatment*	Not applicable	Ash from incineration of 260 cy of soil/ sediment remains.	Ash from incineration of 960 cy of soil/ *sediment/sludge remains.*	Ash from incineration of 9,400 cy of soil/ *sediment/sludge remains.*	Ash from incineration of 19,600 cy of soil/ *sediment/sludge remains.*	In Alternative 6a, ash from incineration of *4650 cy of sediment/soil remains.* In Alternative 6b, ash from 550 cy remains. 4650 cy of sediment/soil remains.
5. SHORT-TERM EFFECTIVENESS						
Community Protection	Not applicable	Implementation creates potential for contaminant transport into laterals, service *lines, or homes (during sewer cleaning) and* for increased dust production (during excavation and construction). Both risks can be greatly reduced by appropriate mitigative measures.	Risks to community virtually the same as with Alternative 2.	Risks to community essentially the same as in Alternatives 2 and 3, except that *excavation is more extensive.*	Risk associated with sewer line cleaning does not exist in this alternative. *Risk associated with dust production is* greater than other alternatives because excavation and construction are more extensive.	Same as Alternative 3
Worker Protection	Not applicable	Protection against dermal contact and inhalation of dust and vapors is required during remedial activities.	Same as Alternative 2, except that larger volumes of material are involved.	Same as Alternative 3, except that larger volumes of material are involved.	Same as Alternative 4, except that larger volumes of material are involved.	Same as Alternative 3
Environmental Impacts	Not applicable	Incineration will meet emission standards. Potential for contaminant migration via dust, stormwater runoff, or floodwater increases during excavation.	Environmental impacts are the same as with Alternative 2, except that more material is incinerated.	Environmental impacts are the same as with Alternative 3, except that more material is excavated and incinerated.	Environmental impacts are the same as with Alternative 4, except that more material is excavated and incinerated.	Same as Alternative 3
Time Until Action is Completed (After *ROD* is signed)	None	3 to 5 years	3 to 4 years	3 to 4 years	3 to 4 years	3 to 4 years

TABLE 5-8 (continued)

COMPARATIVE ANALYSIS OF ALTERNATIVES

Vertac Off-Site FS
Jacksonville, Arkansas

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EVALUATION CRITERIA	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4	ALTERNATIVE 5	ALTERNATIVE 6a and 6b
6. IMPLEMENTABILITY						
Technical Feasibility	Not applicable	Design, construction, and operation are straightforward except in incineration, which is subject to upsets and delays. Cleanup effectiveness is readily determined by subsequent sampling, and additional action can be easily implemented if necessary.	Similar to Alternative 2.	Similar to Alternative 2.	Similar to Alternative 2.	Similar to Alternative 2 except grouting of collection lines is dependent on the level of deterioration of the lines.
Administrative Feasibility	Not applicable	NPDES permit not required to discharge treated wastewater effluent to surface water body. Must coordinate with Jacksonville wastewater authority and Hercules Inc. regarding closeout of West WWTP, sewer line cleaning, and connection with new WWTP. Must coordinate with state air quality agency regarding incinerator emissions. Must show that incineration satisfies RCRA requirements in 40 CFR 264.340 - 264.351. Use restrictions must be coordinated through city of Jacksonville for: • Sludge drying beds • Undeveloped residential areas of Rocky Branch flood plain	Similar to Alternative 2 except: • Use restrictions are not required for sludge-drying beds • Must coordinate with RCRA landfill authorities regarding disposal of incinerator ash • U.S. Army COE Section 404 permit required for construction in a flood plain	Same as Alternative 3, except *no* use restrictions.	Same as Alternative 4.	Same as Alternative 3.
Availability of Services and Materials	Not applicable	Availability of mobile incinerators and filter presses depends on current demand. All other required equipment and services should be available. Capping material should be available locally.	Similar to Alternative 2. Also, RCRA landfills for disposal of incinerator ash are within 500 miles of the site. Materials available for onsite disposal. Large amount of material required for berming may be difficult to obtain locally.	Same as Alternative 3. Alternative 4 requires the largest volume of soil for berming, capping, and backfilling excavated areas.	Same as Alternative 4. Large amount of material required for capping may be difficult to obtain locally.	Same as Alternative 3.
7. COST						
Capital cost	$0	3,900,000	7,600,000	20,000,000	38,000,000	6a - 13,400,000 6b - 10,400,000
Annual O&M cost	$0	(first year) 35,000 (after first year) 33,000	(first year) 61,000 (after first year) 45,000 (additional every 5th year) 10,000	(first year) 110,000 (after first year) 66,000	(first year) 200,000 (after first year) 150,000	(first year) 6a - 57,000 6b - 72,000 (after first year) 6a - 46,000 6b - 58,000
30 year present value cost (5% discount rate)	$0	4,000,000	8,000,000	21,000,000	40,000,000	6a - 14,000,000 6b - 11,000,000

TABLE 5-8 (continued)
Vertac Off-Site FS
Jacksonville, Arkansas

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Appendix A

EPA Memorandum

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

January 26, 1989

MEMORANDUM

SUBJECT: Remediation of Dioxin-Contaminated Sediments Near the Vertac NPL Site

FROM: J. Winston Porter, Assistant Administrator
Office of Solid Waste and Emergency Response (WH-562)

THRU: Renate Kimbrough, M.D. Renate Kimbrough, M.D.
Office of the Administrator (A-101)

TO: Barry Johnson, Director
Agency for Toxic Substances and Disease Registry

Sediments in and along the West Leg of Rocky Branch Creek and Bayou Meto downstream from the Vertac NPL site are contaminated with 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). This memorandum is intended to provide the rationale used by EPA in determining appropriate remedial actions regarding these sediments. Your comments are requested.

A limited number of channel sediment samples from Rocky Branch Creek and Bayou Meto were analyzed in 1984. Additional sampling was conducted in 1987 and again in 1988. TCDD concentrations in these channel sediments reportedly ranged from <0.3 ppb to 2.3 ppb. Rocky Branch Creek bank sediments were sampled in September, 1988. TCDD concentrations in ten composited samples reportedly ranged from 0.50 ppb to 2.30 ppb.

EPA has previously employed 1 ppb as an action level for remediation of TCDD in creek sediments (EPA, 1987). The use of 1 ppb as an action level is based on a Centers for Disease Control (CDC) recommendation developed primarily for direct contact with TCDD-contaminated soils in residential areas. The CDC recommendation is derived from Kimbrough et al. (1984), which described 1 ppb as "...a reasonable level at which to begin consideration of action to limit human exposure to contaminated soil." It also stated, "Environmental situations may vary widely, and whether a certain level of TCDD in soil will give rise to concern has to be evaluated on a case-by-case basis." As this statement indicates, the 1 ppb action level was not intended to be interpreted or applied as an all-encompassing standard.

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Rather, the assumptions and uncertainties underlying its development need to be understood and compared to site-specific circumstances. It should also be noted that 1 ppb does not represent a fine line between safe and unsafe conditions as the term "action level" implies. Rather, it was intended to represent a level of concern. In addition, soil ingestion data developed subsequent to publication of the Kimbrough et al. (1984) article should also be considered.

Evaluation of the risk assessment assumptions used to derive the 1 ppb level in the context of site-specific exposure scenarios applicable to Rocky Branch Creek and Bayou Meto sediments indicates that it is inappropriate to apply this directly as the action level for these sediments.

There are two plausible scenarios by which humans may be exposed to TCDD contaminating Rocky Branch Creek and Bayou Meto sediments. One is direct contact with the affected sediments (resulting in TCDD intake by ingestion, transdermal absorption and/or inhalation). This scenario would be more applicable to exposed bank sediments than to the submerged channel sediments, as the latter are less accessible for direct contact.

The 1 ppb level was developed primarily for residential soils, as opposed to creek sediments. It was based on a cancer risk assessment which incorporated numerous conservative exposure and toxicity assumptions. Prominent among these were assumptions that young children would come into contact with the contaminated soils on a daily basis, and that young children ingest 10 grams of soil per day. Since these two assumptions "drove" the risk assessment (Kimbrough, personal communication), their relevance to the potential for contact with Rocky Branch Creek and Bayou Meto sediments is of particular importance.

The daily contact assumption can be reasonable for residential soils, which would be readily accessible to children. In contrast, the affected Rocky Branch Creek sediments are not as readily accessible, and may be essentially inaccessible to young children. It is also unlikely that children would come into daily contact with Bayou Meto sediments since these are not in a residential area. In addition, the assumption of 10 grams/day soil ingestion has since become viewed as overly conservative; less than 1 gram/day is now viewed as a more reasonable assumption for soil ingestion by "typical" young children (Binder et al., 1986; Clausing et al., 1987; EPA, 1988; LaGoy, 1987). In other words, both of the critical assumptions supporting 1 ppb as a level of concern appear overly conservative for application to Rocky Branch Creek and Bayou Meto sediments.

Another pertinent assumption in Kimbrough et al. (1984) involves the distribution of TCDD in the contaminated areas. More specifically, the 1 ppb designation was predicated on the assumption that 100% of the affected soils are contaminated at peak levels (i.e., assuming uniform distribution of 1 ppb TCDD throughout the area of potential soil contact). The sampling from residential areas near Rocky Branch Creek has shown a few areas (mostly near the creek) with average soil concentrations for TCDD equivalents greater than 1 ppb. Removal of these contaminated soils is in progress. Upon completion of this removal action the average TCDD contamination in surface soil of this residential area will be substantially less than 1 ppb. While the bank of Rocky Branch Creek can be considered a portion of the residential area, it comprises less than 1 percent of the area. The nearly vertical banks of the creek make access to the contaminated soil difficult for the young child. In addition, it is separated from the residential area by a fence. These factors combine to reduce the opportunity for the young child to have even the normal frequency of exposure opportunities to these contaminated soils. Figure 2 in Kimbrough et al. (1984) shows that if 1 percent of the area is contaminated at the maximum concentration, the estimated lifetime excess cancer risk is two orders of magnitude less than if the entire area is contaminated at a uniform concentration. Thus, if the entire creek bank, which represents less than 1 percent of the residential area, is contaminated at a maximum concentration of 2.3 ppb, the estimated excess lifetime cancer risk is equivalent to that if the entire residential area were contaminated to less than 0.023 (0.02) ppb.

The second plausible human exposure scenario leading to TCDD intake from the contaminated sediments is food-chain ingestion.

Based on concern regarding exposure to TCDD via this route, the State of Arkansas Department of Health has imposed an advisory discouraging consumption of fish taken from the affected waterways. For the same reason, ATSDR has previously recommended that an interim action level of less than 1 ppb be achieved in Rocky Branch Creek and Bayou Meto sediments (ATSDR, 1986). ATSDR also recommended monitoring of TCDD levels in edible fish portions, to assist in determining the need for continuation of the State advisory.

Kimbrough et al. (1984) provided no specific acceptable sediment concentrations pertaining to this exposure route. It was stated, however, that acceptable levels for soils which might contaminate waterways (i.e., creek sediments) might have to be lower than 1 ppb due to the potential for bioconcentration of TCDD in fish tissue. A potential for 20,000 fold or greater TCDD

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bioconcentration in fish (National Research Council of Canada, 1981) was mentioned in support of this position.

Results of fish sampling conducted downstream from the Vertac site in 1984 are noteworthy in this regard. TCDD levels were evaluated in fish sampled from sections of Bayou Meto in which sediment TCDD concentrations were less than 1 ppb. TCDD levels in edible portions of those fish ranged from 136 ppt to 704 ppt, well in excess of the 25 ppt FDA concern level.

Both these data and the potential for TCDD bioconcentration would indicate that the ATSDR recommendation to achieve levels less than 1 ppb should not be interpreted as a recommendation to achieve 1 ppb or less. Rather, remediation to levels substantially lower than 1 ppb may be necessary to achieve TCDD levels in edible fish tissue which meet the current FDA concern level of 25 ppt.

To date, neither EPA nor ATSDR have specified sediment TCDD concentrations permissible for unlimited fish ingestion. Therefore, an action level for Rocky Branch Creek and Bayou Meto sediments based on potential risks to human health posed by fish ingestion cannot readily be designated. However, action levels can be based on potential human health risks posed by direct contact with the sediments, in conjunction with continuation of the State of Arkansas Department of Health advisory against consumption of fish taken from the affected waterways. In addition, EPA will be conducting long-term monitoring of TCDD levels in fish and other wildlife in Bayou Meto and Rocky Branch Creek, in accordance with the ATSDR recommendation.

The recommendation of 1 ppb as a level of concern was qualified with, "The appropriate degree of concern for which management decisions are made should consider an evaluation of the specific circumstances at each contaminated site." (Kimbrough et al., 1984). It is clear that the derivation of the 1 ppb concern level was based on soil exposure assumptions which were more than several-fold greater than the exposures to sediments expected in and along Rocky Branch Creek and Bayou Meto. Therefore, assuming a continuing and effective State advisory discouraging ingestion of fish taken from the affected areas, the reported <0.3 ppb to 2.3 ppb TCDD levels in these sediments should not pose an unacceptable health threat. Based on the above evaluation, EPA has determined that no clean up of either the West Leg of Rocky Branch Creek or Bayou Meto to protect human health is necessary.

026074

REFERENCES

ATSDR, 1986. Memorandum dated April 24, 1986 from Jeffery A. Lybarger, ATSDR, to Carl Hickam, Public Health Advisor for U.S. EPA Region VI

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Clausing, P., B. Brunekreef and J.H. van Wijnen. 1987. A method for estimating soil ingestion by children. Int. Arch. Occup. Environ. Health 59:73-82

Kimbrough, R.D., H. Falk, P. Stehr, and G. Fries. 1984. Health implications of 2,3,7,8-tetrachlorodibenzodioxin (TCDD) contamination of residential soil. J. Toxicol. Environ. Health 14:47-93

LaGoy, P.K. 1987. Estimated soil ingestion rates for use in risk assessment. Risk Analysis 7:355-359

National Research Council of Canada (NRCC). 1981. Polychlorinated dibenzo-p-dioxins. Publ. NRCC No. 18574 of the Environmental Secretariat. Ottawa, Canada: National Research Council of Canada

U.S. EPA, 1987. Superfund Record of Decision: Minker Stout/Romaine Creek, MO. EPA/ROD/R07-87/007. September, 1987

U.S. EPA, 1988. Superfund Exposure Assessment Manual. EPA/540/1-88/001. April, 1988

Appendix B

ATSDR Memorandum

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service
Agency for Toxic Substances
and Disease Registry

Memorandum

Date APR 24 1986

From Acting Director
Office of Health Assessment

Subject Health Assessment, Off-site Remedial Investigation,
Vertac Chemical Corporation, Jacksonville, Arkansas SI-85-079

To Mr. Carl Hickam
Public Health Advisor
EPA Region VI

026077

EXECUTIVE SUMMARY

The Environmental Protection Agency (EPA), Region VI Office, submitted data indicating that sludges and sediments in the Jacksonville wastewater treatment plant system (WWTP), Rocky Branch, Bayou Meto, and associated floodplains are contaminated with several compounds including tetrachloro-dibenzo-p-dioxins (TCDD). Because of the potential for human exposure to these compounds, and the potential for a major release of these compounds from the WWTP to downstream water and land resources, the Agency for Toxic Substances and Disease Registry (ATSDR) offers the following recommendations: (1) restrict general public access to the abandoned and existing WWTP, and to the channel and floodway soils of the west leg of the Rocky Branch in the residential area just south of Vertac; (2) prevent additional migration and flood releases of contaminants from the WWTP system, other environmental sinks in Rocky Branch, Bayou Meto, and their floodways, and from Vertac; (3) residential land uses on the Vertac site would constitute an unacceptable health risk; (4) provide additional characterization of both on-site and off-site contamination to determine the need for additional remediation; and (5) implement a health and safety plan for all on- and off-site remedial activities.

STATEMENT OF PROBLEM

The ATSDR has been requested by the U.S. Environmental Protection Agency (EPA), Region VI, to review and comment on the Draft Off-site Remedial Investigation (RI) for the Vertac Chemical Corporation plant, Jacksonville, Arkansas. In addition, EPA has asked us to address the following concerns:

1. The public health significance of the contaminant levels found in environmental pathways.

2. The need for off-site cleanup.

3. Assistance in developing guidelines and criteria for off-site remediation of dioxin-contaminated soils/sludges/sediments to protect public health.

026078

SITE DESCRIPTION AND BACKGROUND

The Vertac Chemical Corporation pesticide plant lies on the site of a former World War II ordnance plant. Pesticides have been produced on the site since 1948 by three former companies. Residential subdivisions lie immediately south and east of the Vertac plant site. The land use to the north and west is primarily undeveloped or commercial/light industrial. For additional background information on the site, please refer to our reports to EPA Region VI dated April 11, 1983, and January 15, 1986, on the Vertac Site and February 25, 1986, on fish data.

LIST OF DOCUMENTS REVIEWED

1. Off-site Remedial Investigation, Draft Report Volume I-Report & Bibliography, Draft Report Volume II- Tables & Appendices, Draft Report Volume III- Maps & Figures, Project No. CH313-6, Site No. 98-6L04, prepared for the EPA under Contract No. 68-01-6692 by CH2M Hill, Inc. and Ecology and Environment, Inc., July 12, 1985.

2. Supplement to the Off-site Remedial Investigation, Draft Report-Delineations & Volumes/A Working Paper, Project No. CH313-6, Site No. 98-6L04, prepared for the EPA under Contract No. 68-01-6692 by CH2M Hill, Inc. and Ecology and Environment, Inc., July 19, 1985.

3. Memorandum dated September 3, 1985, from Mr. Larry P. Rexroat, Superfund Enforcement Section, EPA Region VI, to Mr. Carl Hickam, Public Health Advisor, CDC/EPA Region VI.

4. ATSDR project file.

LIST OF PRINCIPLE CONTAMINANTS

The primary contaminants of concern in off-site areas include: 2,3,7,8-TCDD, 2,4-dichlorophenoxyacetic acid (2,4-D), 2,4,5-trichlorophenoxyacetic acid (2,4,5-T), silvex, chlorinated phenols and benzenes. The RI focussed on 2,3,7,8-TCDD, and used the generic term "dioxin" for 2,3,7,8-TCDD (p. 1-1, Vol. I).

QUALITY CONTROL (QC)

To date, only the 1984 sampling data have received QC. An acceptable evaluation of the QC for the 1984 data was provided in Appendix 10 (Vol. III).

SITE INSPECTION

On March 5 and 6, 1986, ATSDR conducted a site inspection and met with Mr. Larry Rexroat, Project Officer, and Mr. Larry Right of EPA Region VI, and Richard Saterdal of CH2M Hill. Please refer to Attachment 1 summarizing ATSDR's itinerary, information obtained, and problems observed during the site inspection. Photographs were taken of both the Vertac site and off-site areas.

ENVIRONMENTAL SAMPLING

In December 1983, seventy-four sediment and soil samples were collected in the off-site study area and analyzed for "dioxin," 2,4-D, 2,4,5-T, silvex, chlorinated benzenes, chlorinated phenols, and other organics. Forty of the seventy-four samples contained "dioxin" (See Tables 5-1 & 5-2, Vol. II, and refer to Attachment 2).

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In June 1984, twenty-one soil samples were collected in areas within 600 feet of Bayou Meto that, judged by visual inspection, had been frequently flooded. These samples were analyzed for "dioxin." Only one of these contained measurable levels (0.43 ppb) of "dioxin."

In August 1984, 225 field samples of soil and sediments were collected for "dioxin" analysis; 29 additional samples were collected for background and quality control. Seventy-nine of the 225 field samples contained measurable amounts of "dioxin" ranging from 1.0 ppb to more than 200 ppb. Until this particular sampling effort, the abandoned WWTP and the existing WWTP aeration pond "...had never been sampled..." (p. 5-7, Vol. I). In addition, Rocky Branch and Bayou Meto had only been sampled at road and railway crossings; this sampling effort included other sediment sampling locations in the stream channels as well as soils throughout the 2-year and 5-year floodplains. Please refer to Attachment 2 for a summary of the "dioxin" data.

The highest 2,4-D level (20,000 ppm) and the highest 2,4,5-T level (7,200 ppm) were found in a 1984 sludge sample from WWTP manhole #7 (I016A). This same sludge sample also contained the highest "dioxin" level (>200 ppb) found during the 1984 sampling and analysis effort. The highest concentrations of silvex were found in 1983 in sludge samples from an abandoned interceptor/manhole #2 (67 ppm, I-5) and a new interceptor/manhole #19 (<100 ppm, I-4). Hexachlorobenzene (300 ppm, I-3), pentachlorophenol (300 ppm, I-3), chlordane (48.3 ppm, I006A), and 2,4,6-trichlorophenol (5.7 ppm, I016A) were also found in the WWTP collection system sludge. In the vicinity of Hines Cove along Rocky Branch west leg, 2.8 ppm PCB 1254, 1.5 ppm 2,4-D, and 2.7 ppm 2,4,5-T (N030A) were found in a 1984 floodplain soil sample (N030A).

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ENVIRONMENTAL PATHWAYS

Food Chain Uptake

Bioconcentration has been documented in aquatic organisms downstream of both the Vertac plant in Rocky Branch and the Bayou Meto and the WWPT outfall in the Bayou Meto. Fish samples collected as far as 15 miles downstream from Rocky Branch contained levels of 2,3,7,8-TCDD in the edible portions that exceeded FDA's Great Lakes advisory level. Whole fish samples collected in Bayou Meto as far as 75 miles downstream (Bayou Meto Wildlife Management Area) of Rocky Branch have been found to be contaminated.

Air Transport

Large ground surface areas are exposed on the site to water and wind erosion. This raises the possibility of off-site migration of contaminants through the air. In addition, the potential for subsurface transport of volatile gas vapors from the waste landfills should be explored.

Surface Water/Sediment Transport

Sediment transport of 2,3,7,8-TCDD and other hazardous substances from the site to Rocky Branch, Bayou Meto, and the sewage treatment plant has been observed. The Rocky Branch and the Bayou Meto downstream of the Vertac site flow adjacent to several residential subdivisions, individual homes, agricultural lands, industrial and commercial areas, and recreational areas such as Dupree Park.

Rocky Branch:

In the Rocky Branch channel and floodplain, "dioxin" levels in the 1984 sediment samples ranged from the detection limit (i.e., varies from 0.02 to 0.70 ppb) to 7.58 ppb. The levels appear to decrease with distance from the Vertac plant site to 0.74 ppb (questionable result) just above

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leg of Rocky Branch near the West Lane dead end (3.01 ppb, N026C) and near the end of Hines Drive (7.58 ppb, N030C). These levels are of particular concern because of their proximity to residences. Detectable "dioxin" levels ranged from 0.15 to 0.74 ppb for in-stream sediments.

While no 1984 samples were collected from the east leg of Rocky Branch, seven locations were sampled in 1983 in the east leg watershed. Three of the sample locations (N-8, N-12, & N-16) were below Vertac's East Ditch discharge. The data results indicate the need for additional sampling to assure that TCDD contamination does not exist in the residential areas east and south of the Vertac plant.

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Bayou Meto:

Bayou Meto channel and floodplain sediment samples in 1984 showed concentrations of "dioxin" ranging from the detection limit to 2.1 ppb. The highest "dioxin" concentrations were found between the WWTP outfall and a point about 2000 feet downstream of the Highway 161 bridge. The highest "dioxin" level found in 1984 was the estimated maximum concentration of 3.5 ppb (F047A) in a near-stream, near-surface sediment sample; this was found about 25 feet downstream of the WWTP outfall in Bayou Meto and 150 feet from the left bank's water edge. The detectable "dioxin" levels found in the 1984 in-stream sediment samples ranged from 0.10 to 0.39 ppb in shallow sediments and from 0.10 to 1.10 ppb for deeper sediments.

Wastewater Treatment Plant (WWTP) System:

Sludge and sediment samples in the WWTP collection and treatment system revealed an average concentration of 21.5 ppb "dioxin" which included the three highest values (70.5, 119.4, and >200 ppb). Sampling in 1984 of the abandoned WWTP found 6.59 ppb "dioxin" in the sludge drying beds and 12.46 ppb "dioxin" in the digestor. In the existing WWTP facilities, 1984 sludge samples in the aeration lagoon were found to have maximum levels as high as 37.9 ppb (S018A, invalid or questionable data) and 16.2 ppb (S019A). Sludge samples in the oxidation ponds were found to contain maximum "dioxin" values of 8.37 ppb in 1979, and 3.6 ppb in 1984.

According to the RI, manhole #106 (200 feet south of Vertac property in the west leg of Rocky Branch between Braden & Alta Cove) was noted during the 1984/1985 sewer sampling investigation (Table 4-6, Vol. II) to overflow. The RI also described manholes #1198, #1202, #1206, and #301 to overflow. The overflow potential for other manholes in the residential areas immediately south and east of the Vertac site during major storms should be described. The interceptor which serves the residential subdivision immediately south of Vertac was found to contain the three highest "dioxin" concentrations (see above) in sewer sludges/sediments.

Agricultural Uses Downstream:
Efforts have not been made to identify existing or zoned agricultural areas along Bayou Meto downstream of the WWTP or Rocky Branch to a point upstream of Southeastern Avenue that may have been affected by flooding and contaminated sediments. Of these agricultural areas, feedlot and grazing areas in the floodplain are the most important since 2,3,7,8-TCDD accumulates in the tissues of grazing cattle and rooting swine. Cattle grazing areas and other agricultural activities were observed during the site inspection. Each of these areas should be sampled. Note that levels of 2,3,7,8-TCDD in soils from 0.0062 to 0.079 ppb have been projected by Kimbrough et al.[4] to produce maximum allowable residues of 2,3,7,8-TCDD in foods (i.e., beef, pork, and milk).

Sediments in the vicinity of three Bayou Meto surface water withdrawal points may be of public health concern for certain agricultural uses. We note that site 25 (about 500 feet upstream of Highway 67/167) withdraws for waterfowl purposes, site 13 (near Highway 161) withdraws for 60-acres of rice, and site 11 (about 0.3 miles upstream of Southeastern Ave.) withdraws for 280-acres of rice. While site 25 lies about 1000 feet downstream of the sediment sampling station containing the two highest

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"dioxin" values (2.1 and 3.5 ppb) found in the Bayou Meto, the Bayou Meto channel sediments next to the lake at site 25 were not found to contain "dioxin." The collection and analyses of a few additional sediment and biologic samples may be prudent if (1) the waterfowl may be consumed, or (2) flooding may have occurred since the last sampling period. The Bayou Meto sediments in the vicinity of site 13 appear to have a history of exceeding 1 ppb "dioxin."

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EXPOSURE PATHWAYS

The most likely exposure pathways for local residents, City Beautification employees, and WWTP employees to the contaminants of concern would be by direct contact with contaminated sludges/sediments/soil and inhalation of contaminated dust. If small children play in contaminated yards or garden soils, in the west leg of Rocky Branch just south of the Vertac plant, or live in the immediate area, they may be subject to exposures through direct contact and ingestion of contaminated soil or dust. Other probable exposure pathways include the ingestion of food crops grown in contaminated sludges and soils, ingestion of local fish (and possibly other local wildlife), and ingestion of farm animals that graze on or are confined to lands containing contaminated soils/sediments.

HEALTH EFFECTS

For ATSDR's discussion on the health effects of 2,3,7,8-TCDD, 2,4-D, and 2,4,5-T, please refer to our Health Assessment report on the Jacksonville Landfill dated October 23, 1985.

The section of the RI dealing with the toxicologic and carcinogenic effects of TCDD exposure is adequate. However, the "Human Effects" section requires several revisions. First of all, it should be noted that the reproductive data collected following the Seveso incident are still being evaluated. Secondly, the concluding statements derived from the case study of the 55-year-old woman need to be re-examined. The elimination half-life for TCDD in a variety of animal species ranges from 10 to 43 days. In addition, McNulty reported the TCDD elimination half-life in the fat of monkeys was approximately 365 days. For the case in question, 58 percent of the recovered TCDD was taken from adipose tissue. It is impossible, in the absence of human data, to predict whether twenty, several, or no half-lives may have occurred in the seven month period. Therefore, it is inaccurate to definitively state "...the people included in this study accumulated large amounts of dioxin..." Furthermore, it is unacceptable to compare actual amounts (ug, mass units) of an absorbed toxicant between differing species without normalization to factors such as body weight, surface area, metabolic rate, or life span. If the total amount of dioxin (40 ug) calculated for the case in question, is normalized to body weight (70 kg), the actual absorbed dose (0.57 ug/kg) is not 1000 to 3000 times higher than the tolerable dose calculated (LD50= 0.6 ug/kg) using guinea pig acute toxicity data.

OTHER DISCUSSION

Existing and Abandoned WWTP:

Of special concern is the fact that the WWTP's oxidation ponds would be subject to inundation by floods equal to or greater than a 5-year flood (p. 3-20, Vol. I; Table 4.1, Vol. II; Plates 4-1 & 4-2, Vol. III). Because a mass release from the oxidation lagoons as a result of major storm could spread 2,3,7,8-TCDD-contaminated materials to an extensive area downstream, remedial effort must be taken to reduce this potential impact.

In inspecting the site and the RI exhibits (Plate No. 3-10, Vol. III) of the "Old Sewage Treatment Plant," the police shooting range portrays features that reveal the possible existence of some previous treatment works that may have been covered after being abandoned. This area should be sampled if it was a part of the old treatment works.

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Rocky Branch/Bayou Meto:

Multiple land uses exist downstream of the Vertac site and the existing WWTP. These include residential, industrial, commercial, agricultural, and unzoned areas. Cleanup levels for 2,3,7,8-TCDD in sediments/soils in downstream land use areas should depend upon the potential human exposure associated with these land uses. The future development potential and realization of the undeveloped floodplain areas depend upon the Flood Damage Prevention Ordinance dated September 15, 1977. Since this floodplain ordinance does permit construction of new structures, cleanup levels for currently undeveloped floodplain/floodway land uses should still apply. 026086

Existing residences along both the east and west leg of Rocky Branch may be subject to a variety of flood events. Residences on Alta Cove, Alta Lane, Hill Road, and the ends of Braden, West Lane, Hines Lane, and Hines Cove, and at the Willow Bend Apartments off Marshall Road lie within the 100-year floodplain, the designated floodway, or the 2-year or 5-year floodplain. Many of the residential yards incorporate the Rocky Branch creek banks as part of the yard and lack any physical barrier between the yard and the creek. Toys, play areas, and human paths were observed in and next to the Rocky Branch channel and banks.

Currently, health advisory levels for 2,3,7,8-TCDD in fish have been developed only for the Great Lakes. The ATSDR has previously recommended that FDA determine whether the Great Lakes health advisory for 2,3,7,8-TCDD in fish should be revised for the Jacksonville area. The justification for a cleanup level for 2,3,7,8-TCDD in waterway sediments, and/or soils subject to erosion, should depend upon the potential for human exposure. If the existing fish ban for the Jacksonville area is ineffective in preventing human exposure from the affected food-chain, additional remedial efforts would be required. If soil sampling of agricultural land uses along the Bayou Meto channel and floodway downstream and subsequent biological sampling reveal unacceptable exposure to farm animals, additional remedial measures would be required.

RECOMMENDATIONS

The ATSDR offers the following recommendations to safeguard public health from the contamination of off-site areas and to better assess the public health hazard associated with this contamination. These recommendations are made assuming the term, "dioxin," that is used in the RI is meant to be equivalent to 2,3,7,8-TCDD. This is stated in the RI (p. 1-1, Vol. I).

1. Specify what dioxin isomers were analyzed for in the RI "dioxin" data.

2. Obtain total and isomer specific data for determining the 2,3,7,8-TCDD equivalents in off-site soil/sediment/sludge samples.

3. Restrict general public access, including the Jacksonville Department of Beautification employees, to the abandoned WWTP facilities (i.e., sludge drying beds, adjacent surface soils, digestor, trickling filter(s), clarifiers, sewage interceptors, pump house, and possible other contaminated facilities), the existing WWTP facilities (distribution/bypass pipelines and boxes, aeration lagoon, oxidation lagoons), and adjacent soils at the existing WWTP.

4. Develop a health and site safety plan for workers in accordance with OSHA standards. Outline the activities associated with contaminated areas in this plan and require individuals who engage in those activities to wear personal protective gear/clothing in accordance with OSHA standards and NIOSH guidelines.

5. Restrict all general public access to both the channel and the floodway of the west leg of Rocky Branch from the Vertac property line to West Main Road in the residential area south of Vertac until up-to-date soil and sediment sampling data are made available.

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6. Insure that migration of contaminants via surface runoff on the Vertac site to off-site areas, particularly Rocky Branch, is no longer occurring.

7. Insure the adequacy of existing control measures on the Vertac site to avoid unacceptable releases, spills, or discharges of 2,3,7,8-TCDD and other contaminants of concern to the WWTP. Where existing measures are determined ineffective, implement additional on-site remedial measures.

8. Prevent existing pretreatment sumps on the Vertac site from bypassing site contaminants to Rocky Branch. Monitor discharges from Vertac site periodically.

9. Sample and analyze sediments for 2,3,7,8-TCDD and other contaminants of concern on the Vertac site in the Rocky Branch, East Ditch, South Ditch, the Central Ditch, and other drainage ditches.

10. Investigate the need for additional remediation of certain on-site areas (i.e., portions of Rocky Branch and drainage ditches that have not received any previous remediation, or drainage ditches that appear to bypass the pretreatment system) before implementing off-site remediation of contaminated channel sediments or floodplain soils downstream.

11. Request local authorities to prohibit residential land uses within the Vertac site boundary (Plate 5-2, V.III). Request that action be taken to permit no one to live on the site. Include anyone currently residing on the Vertac site in the State's exposure study.

12. Sample the surface soils in the immediate vicinity of the mobile home found on-site and its interior dusts for 2,3,7,8-TCDD and other contaminants of concern. Insure that the mobile home residence on the

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site is properly cleaned if it is found to be contaminated and moved off-site.

13. Perform sampling and analysis of surface soils around manholes that are downgradient of the Vertac site, have a history of overflow, or have the potential to overflow.

14. Investigate the potential for wastewater overflows in any building floor drains that may be connected to a 2,3,7,8-TCDD-contaminated WWTP interceptor having a history of surcharge.

15. Prevent the continued degradation of Bayou Meto and Rocky Branch by the transport of contaminants of concern from both on-site and off-site sources of contamination.

16. Perform detailed (fine grid) sampling and analysis of channel sediments and floodplain soils for 2,3,7,8-TCDD and other contaminants of concern in and along the west leg and east leg of Rocky Branch between the Vertac property line and the confluence point of both Rocky Branch legs.

17. Perform fine grid sampling and analysis of channel sediments and floodplain soils for 2,3,7,8-TCDD and possibly other contaminants of concern in depositional areas of Rocky Branch, upstream of its confluence with Bayou Meto, and Bayou Meto between the WWTP outfall and 2000 feet downstream of the Highway 161 bridge. Conduct this sampling or additional sampling after remediation of the upstream areas.

18. Perform fine grid sampling and analyses of soils/sediments for 2,3,7,8-TCDD in the Bayou Meto floodplain adjacent to and in the Woodhaven Mobile Home Park near Highway 161.

19. Perform sampling and analyses of floodplain soils/sediments for 2,3,7,8-TCDD and other contaminants of concern in any pastures, feedlots, or farms upstream of the Southeastern Avenue bridge in the Bayou Meto floodplain. Conduct sampling to a depth greater than that which would be disturbed by local farm equipment.

20. Perform monitoring and analyses of surface waters for contaminants of concern and other priority pollutants in Rocky Branch and in Bayou Meto adjacent to residential areas. Designated uses and applicable water quality standards should be disclosed for the affected waterways and compared with the monitoring data.

21. Consider the following guidance criteria for dioxin remediation:

a. Municipal Wastewater Collection System

(1) Prevent human exposure to sludges, wastes, and sediments containing 2,3,7,8-TCDD and other contaminants of concern in the affected sanitary sewer and/or stormsewer collection system (abandoned and existing).

(2) Prevent the above contaminants from contaminating the future sewage treatment plant and any new interceptors.

b. Abandoned WWTP Facilities

(1) Prevent exposure of the general public to contaminated sludges, wastes, soils, and sediments in the abandoned sewage treatment facilities.

(2) Prevent these contaminated materials from contaminating the future sewage treatment plant and collection system via any subsurface sewer connections or surface runoff.

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(3) Consider requiring surface soils in and around the abandoned sewage treatment facilities to meet an action level of not more than 5-7 ppb 2,3,7,8-TCDD after remediation. [This is justified because of the infrequent contact with surface soils by the general public, and because the present land use practices in the vicinity of the abandoned WWTP do not appear to be any more intensive than the commercial areas of the Ironbound District near Newark, New Jersey, where EPA Region II established a similar action level[6].]

(4) Impose the following conditions on the above 5-7 ppb action level:
-The uses and activities of the site must not become associated with the production, preparation, handling, consumption, or storage of food or other consumable items, and food packaging materials.

-Site soils must be protected from erosion that would uncover or transport 2,3,7,8-TCDD causing unacceptable human exposure at a future date (refer to section on EXPOSURE PATHWAYS for possible exposure pathways).

(5) Reevaluate the applicability of the 5-7 ppb action level if present land use is changed and 2,3,7,8-TCDD is left on the site in surface or subsurface soils at levels greater than 1 ppb.

c. Existing WWTP Facility

(1) Prevent exposure of the general public to contaminated sludges, wastes, sediments, and soils.

(2) Prevent effluent discharges or surcharge releases of 2,3,7,8-TCDD-contaminated materials and other contaminants of concern in the treatment system to Bayou Meto and make every possible effort to achieve desired wastewater treatment in the interim until the future WWTP is on-line in July 1987.

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(3) Reduce the potential for a major release of 2,3,7,8-TCDD-contaminated materials and other contaminants of concern from the oxidation lagoons due to a major flood event.

(4) Prevent the contaminated materials from contaminating the future WWTP and collection system.

(5) Prevent the sludges, sediments, wastes, and soils containing 2,3,7,8-TCDD and other contaminants of concern in the treatment system and adjacent soils from migrating to and contaminating additional off-site areas.

(6) Consider using an action level less than 1 ppb 2,3,7,8-TCDD to prevent unacceptable human exposure in the future for those lands in and west of the oxidation lagoons that are zoned residential, or requesting local authorities to investigate the feasibility of rezoning lands contaminated with 2,3,7,8-TCDD to a less sensitive land use.

(7) Implement remedial measures to eliminate future releases of 2,3,7,8-TCDD from the site and avoid bioaccumulation in the foodchain, particularly food fish, and prevent adverse impacts upon other sensitive land uses downstream.

(8) For areas on the existing WWTP site which are zoned for manufacturing and which would be protected from erosion by surface runoff or potential flood events, consider using the action level of not more than 5-7 ppb 2,3,7,8-TCDD with the conditions discussed above under 21.b.(3), (4),& (5).

d. <u>Rocky Branch and Bayou Meto Channels and Floodplains</u>

(1) Insure that existing residential yards contain levels < than 1 ppb 2,3,7,8-TCDD in surface soils and sediments to minimize unacceptable human exposure.

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(2) Recognize that "adequate cleanup of residential areas, from a public health perspective, requires that the concentration of TCDD left in surface soil be less than one ppb."[5] [Note that Kimbrough et al.[4] and Dr. Vernon Houk [3,5] of CDC stated that levels at or above 1 ppb 2,3,7,8-TCDD in residential soils cannot be considered safe and "...constitute an unacceptable risk to human health."]

(3) For currently undeveloped lands zoned for residential land use, consider using an action level less than 1 ppb 2,3,7,8-TCDD to prevent unacceptable human exposure in the future, or requesting local authorities to investigate the feasibility of rezoning contaminated lands to a less sensitive land use.

(4) For floodplain areas along the affected channel and floodways which are used or zoned for industrial or commercial uses, and which would be protected from erosion by surface runoff or potential flood events, consider using an action level of not more than 5-7 ppb 2,3,7,8-TCDD with the conditions discussed above under 21.b.(3), (4), & (5).

(5) For agricultural areas in the affected floodplains, make site-specific requests for a health assessment where justified by additional soil sampling and soil levels of 2,3,7,8-TCDD and other contaminants of concern, or by biological data.

(6) To minimize the bioaccumulation potential of 2,3,7,8-TCDD in the aquatic foodchain, consider achieving an interim action level of less than 1 ppb 2,3,7,8-TCDD in channel sediments and floodplain soils subject to erosion and transport processes. [This recommendation is based on existing sampling data that reveals that (a) all edible fish samples (136 ppt to 704 ppt 2,3,7,8-TCDD) collected in 1984 downstream of the Vertac site and the WWTP outfall to a point (BM3) 3 1/2 miles downstream on Bayou Meto from its confluence with Rocky Branch

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exceeded FDA's Great Lakes health advisory (25 ppt) for 2,3,7,8-TCDD in fish, and (b) in-stream, near-surface sediments collected in 1984 were equal to or less than 0.39 ppb 2,3,7,8-TCDD in the Bayou Meto from a point 200 feet upstream of the Highway 161 bridge (a point far upstream of BM3)]. Conduct future evaluations of Bayou Meto edible fish tissue portions in accordance with FDA's procedures to assist appropriate State authorities determine the necessity for maintaining the present fish ban.

22. Develop and implement special erosion control criteria and a contigency plan for remedial operations to avoid any further transport of contaminants downstream.

22. Revise the human effects section of the RI to reflect the comments made under HEALTH EFFECTS above.

23. To obtain information on the possible disposition of previously dredged sediments, contact the U.S. Army Corps of Engineers for information on any permits for maintenance of channels near bridges and construction of new roads that may have been performed in Rocky Branch and Bayou Meto.

REFERENCES

Please refer to Attachment 3.

We appreciate the opportunity to provide recommendations on this off-site remediation. We thank you and Messrs. Rexroat, Right, and Saterdal for their assistance in our inspection of the site.

Ralph Touch
for
Jeffrey A. Lybarger, M.D.

Attachments

026094

ATTACHMENT 1: SITE INSPECTION

Itinerary

March 5, 1986:

1. Visited Mr. Dick Morris, manager of the City of Jacksonville Wastewater Utility, for general information on how the wastewater collection and treatment system is affected by the Vertac Plant. Visited the existing wastewater treatment plant (WWTP) which receives wastes from the Vertac Plant. Observed the abandoned portion of the old WWTP (clarifiers, trickling filters, digestor, and sludge drying beds), as well as those WWTP facilities (aerator, oxidation lagoons) currently be used.

2. Flew over the Vertac Plant, adjacent residential areas, downstream floodplain areas of Rocky Branch and Bayou Meto, and the WWTP.

3. Drove on the Vertac Plant site to see drainage pathways and how effective past remedial measures have been in containing on-site wastes.

March 6, 1986:

1. Drove off the site to see potentially affected residential areas, recreation areas, and drainage pathways and their association with adjacent land uses.

2. Visited Mr. Duane Reel, City Engineer, for information on current and projected land use zoning in areas around the Vertac Plant and downstream in the floodplain. Zoning maps and flood maps were obtained.

Problems Observed

1. According to the City Engineer, the WWTP is in violation of its discharge permit effluent limitations but the City has indicated that they are unable to do anything about it because of the dioxin contamination in the WWTP system. The oxidation lagoons are nearly

full and have inadequate retention time left. The City is waiting for EPA to take action on cleaning up the existing WWTP system and ponds. The connection of the new interceptor to the future WWTP (scheduled for completion in July 1987) will depend upon the approved cleanup of the WWTP interceptor system.

2. Possible evidence of air pollution exist around the existing WWTP aerator. The City Engineer pointed out numerous dead trees on the northwest side of the aeration lagoon, and suggested that air pollution from the aeration lagoon may be responsible.

3. The public has excess to the abandoned WWTP areas which are contaminated. Both potential health and safety hazards exist. The City is using the contaminated sludge drying beds for growing garden vegetables (i.e., tomatoes, cabbage, etc.) and other plants. Photos were taken. Levels of 2,3,7,8-TCDD as high as 7 ppb have been found in the sludge drying beds. A potential health hazard exists because of human contact, possible transport of contaminants to the home — environment, and ingestion of possible contaminants in and on vegetables. No record exists of past people who have removed sludge for home garden use.

4. The oxidation lagoons could be inundated by a 5-year flood event. The lagoons contain many contaminants including 2,3,7,8-TCDD.

5. No sampling has been done after on-site remedial work in the upper portions of Rocky Branch for either the east leg or west leg.

6. Noxious odors were apparent both on the Vertac site and in downwind areas in residential areas south and east of the Vertac Plant site. It could not be determined if these odors were related to current production activities or wastes disposed or stored on-site.

7. Drainage (East Ditch, South Ditch, & Central Ditch) from the Vertac Plant does not receive proper pretreament because of sump bypass

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features and inadequate capacity during storm periods. Photos were taken.

8. Portions of Rocky Branch exist on the Vertac site that were not included in the on-site remedial work.

9. Despite the newly installed french drain, seeps were observed between the new slurry wall and Rocky Branch in the area of the on-site burial site. Aerial photos were taken.

10. Evidence exists that children probably play in Rocky Branch immediately downstream of the Vertac Plant property line. Toys and numerous footpaths were found in and along Rocky Branch in the subdivision immediately south of the Vertac Plant. Photos were taken.

11. A mobile home residence was observed on the Vertac site (Plate 5-2, Vol. III) about 800 to 1000 feet from the highly contaminated "T-wastes" (drums containing 30 ppm 2,3,7,8-TCDD), and 1000 feet from 25,000 drums containing "D-wastes." The residents of this mobile home appear to have access to the site by a locked backgate. A dog and toys were seen observed in the yard. Photos were taken.

12. Some residential yards immediately downstream of the Vertac Plant share an intimate association with both the west and east legs of Rocky Branch.

13. Some Bayou Meto floodplain areas downstream of the Vertac Plant and the WWTP are used for grazing, crop production (rice and soybeans), and possibly other agricultural purposes.

14. Even though a flood prevention ordinance exists, portions of the floodplain can still be developed for residential purposes and other

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ATTACHMENT 2: SUMMARY OF DIOXIN LEVELS FOUND IN OFF-SITE AREAS, JACKSONVILLE, ARKANSAS

LOCATION	SAMPLE DATE	DIOXIN[c] (ppb)	(Sample No. or (Reference)	LABORATORY	QUALITY CONTROL
Residential yard:	1979	4.2 (Braden St.)	(p.2-4,V.I)	-	
	1979	2.6 (W. Lane)	(p.2-4,V.I)	-	
	1982	ND	(p.2-5,V.I)	-	
Abandoned WWTP:					
Sludge drying beds	1984	6.59	(S028B)	DF004010	
Digestor	1984	12.46	(S025B)	DF004306	
Clarifier	1984	1.62	(S026A)	DF004304	
Sludge Collection Area	1984	1.19 (30'NE of kennel)	(S022X)	DF004309	
Existing WWTP:					
Aeration lagoon	1984	37.9	(S018A)	DF003609	e_2
Oxidation lagoon	1979	8.37 (north pond)	(p.2-4,V.I)	-	
	1979	7.75 (south pond)	(p.2-4,V.I)	-	
	1981	3.4 (composite)	(p.2-4,V.I)	-	
	1984	3.6 (north)	(S011A)	DF003612	e_1
Sewerline	1979	1.13	(p.2-4,V.I)	-	
Manhole	1981	10.9 (Braden & Alta)	(p.2-4,V.I)	-	
Manhole #71	1983	33.4 (Braden & Alta)	(N-11)	-	
Manhole #77	1984	>200 (nr SE of Vertac)	(I016A)	DF003604	$e_{1,2}$
Manhole #76	1984	119.4 (Hill Rd.)	(I013A)	DF004116	e_1
Manhole	1984	22.3 (Braden & Alta)	(N011A)	DF004105	e_1
Rocky Branch:					
West leg[a]	1981[b]	0.27	(p.2-4,V.I)	-	
	1983[a]	3.2 (near Alta Cove)	(N-21)	-	
	1984	3.01 (nr W. Lane end)	(N026C)	DF003514	
	1984[a]	7.58 (near Hines Cove)	(N030C)	DF003913	
East leg[a]	1981	0.61 & duplicate=0.535 (Marshall Rd ditch)	(Table 5-1,V.III)		
	1981	0.535 (Hill Rd)	(Table 5-1,V.III,p.5-20)		
	1981	0.8 (SE corner Vertac)	(Table 5-1,V.III,p.5-20)		
	1983	0.17 (Hill Rd)	(N-8)	-	
2-Yr Floodplain	1984	1.7 (near WWTP)	(F104A)	DF004212	
	1984	1.5 (near WWTP)	(F105C)	DF004210	
At Highway 67/167	1979	2.5	(p.2-4,V.I)	-	
	1981	<1.0	(p.2-4,V.I)	-	
	1983	1.15	(F-10)	-	
At Bayou Meto	1984	0.74 (100 ft above BM)	(F014A)	DF003620	e_1
Bayou Meto:					
At WWTP discharge	1984	2.1	(F047C)	DF003315	e_1
Floodpl. S Lk. Dupree	1984	1.38	(F085C)	DF003817	
Just Above Mo-Pac.RR	1984	1.32	(F060B)	DF003405	
At Mo-Pac.RR	1983	1.02	(F-17;Plate 5-1,V.III)	-	
At Highway 161[a]	1979	1.6	(p.2-4,V.I)	-	
	1981	<1.0	(p.2-4,V.I)	-	
	1984[a]	1.10 (200 ft upstream)	(F071X)	DF004001	
Below Highway 161	1984	1.08 (2000 ft downstr)	(FS025C)	DF004004	

Data prior to the RI are limited due to inadequate quality control.
The 1983 oxidation lagoon samples were taken from hard bottom sediments.
a=Sample locations lie very near and/or in intimate association with residential areas.
b=Can not be verified by Table 5-1 in Vol. II for the west leg; however, 0.27 was found at West Main & Rocky Branch.
c=Dioxin was used generically throughout RI; however p. 1-1,V.I identified dioxin as 2,3,7,8-TCDD.
e1=laboratory precision for duplicates can not be determined due to one of the duplicates being non-detectable.

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ATTACHMENT 3:

REFERENCES

1. U.S. Environmental Protection Agency, National Interim Primary Drinking Water Regulations, Appendix A Background Document, EPA-570/9-76-003, 1976.

2. Sax, N. Irving, Dangerous Properties of Industrial Materials, Sixth Edition, 1984.

3. Letter dated July 8, 1984, from Dr. Vernon Houk, CDC, ATSDR, to Mr. Morris, U.S. EPA, Region VII.

4. Kimbrough, Renate D., Falk, Henry, and Stehr, Paul of Center for Environmental Health, CDC, and Fries, George of Department of Agriculture, Health Implications of 2,3,7,8-TCDD Contamination of Residential Soil, Journal of Toxicology and Environmental Health, 14:47-93, 1984.

5. Letter dated July 9, 1984, from Dr. Vernon Houk, CDC, ATSDR, to Mr. Dewling, Regional Adminstrator, U.S. EPA, Region II.

6. Memorandum dated October 26, 1984, from Ms. Georgi Jones, Chief, Superfund Implementation Group, CDC/ATSDR, to Mr. David P. Knorowski, Public Health Advisor, EPA Region II.

Appendix C

Detailed Description of Applicable or Relevant and Appropriate Requirements (ARARs)

Appendix C

DETAILED DESCRIPTION OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

Congress mandated, in Section 121(d) of the 1986 Superfund Amendments and Reauthorization Act (SARA), that site cleanups conducted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund), comply with the requirements of all federal and duly promulgated state environmental and public health laws. These laws are known in the Superfund program as Applicable or Relevant and Appropriate Requirements (ARARs).

DEFINITIONS

Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.

"Applicability" implies that the remedial action or the circumstances at the site satisfy all of the jurisdictional prerequisites of a requirement. For example, the minimum technology requirement for landfills under RCRA would apply if a new hazardous waste landfill unit (or an expansion of an existing unit) were to be built on the Vertac site.

Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. However, in some circumstances, a requirement may be relevant but not appropriate for the site-specific situation.

The relevance and appropriateness of a requirement can be judged by comparing a number of factors, including the characteristics of the remedial action, the hazardous substances in question, or the physical circumstances of the site, with those addressed in the requirement.

A requirement that is judged to be relevant and appropriate must be complied with to the same degree as if it were applicable. Moreover, remedial actions must comply with a relevant and appropriate requirement that is more stringent than an applicable requirement. If, for example, a federal standard is "applicable" while a more stringent state standard is "relevant and appropriate," the more stringent State standard will govern. However, there is more discretion in the determination of relevance and appropriateness. It is possible for portions of a requirement to be considered relevant and appropriate, while the rest may be dismissed as irrelevant.

In order for state environmental statutes or regulations to be considered potential ARARs they must satisfy five criteria:

1. Be promulgated standards
2. Be more stringent than federal requirements
3. Be identified to EPA in a timely manner
4. Not result in a statewide prohibition on land disposal
5. Be consistently applied statewide

It is EPA's policy that state ARARs be achieved to the greatest extent practicable.

CRITERIA TO BE CONSIDERED (TBCs)

In addition to legally binding laws and regulations, many federal and state environmental and public health programs also develop criteria, advisories, guidance, and proposed standards that are not legally binding, but that may provide useful information or recommended procedures. If no ARARs address a particular situation, or if existing ARARs do not ensure protectiveness, these criteria to-be-considered (TBCs) should be used to set cleanup targets.

APPLICATION OF ARARs

ARARs, in accordance with 40 CFR Section 121(d)2(A), apply only to actions or conditions that are located entirely on site. Section 121(e) of CERCLA states that no federal, state, or local permit is required for remedial actions conducted entirely onsite. Therefore, actions conducted entirely onsite must meet only the substantive requirements of the ARARs, not the administrative ones. Any action that takes place off-site is subject to the full requirements of federal, state, and local regulations. This is an important distinction.

Onsite is defined by Section 300.5 of the National Contingency Plan (NCP) as "...the areal extent of contamination and all suitable areas in very close proximity to the contamination necessary for implementation of the response action." It is important to clarify, at this point, that even though the areas addressed by this Feasibility Study are referred to as the "off-site" areas, these areas are part of the areal extent of contamination of the Vertac Superfund site and thus are actually "onsite." The use of

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the term "off-site" is only used to denote those areas not within the boundary of the Vertac plant itself. Therefore, the response actions implemented within the areas addressed by this Feasibility Study do not require permits.

SUBSTANTIVE AND ADMINISTRATIVE REQUIREMENTS

In determining the extent to which onsite CERCLA response actions must comply with other environmental and public health laws, one should distinguish between substantive requirements, which may be applicable or relevant and appropriate, and administrative requirements, which are not. Substantive requirements are those requirements that pertain directly to actions or conditions in the environment. Examples of substantive requirements include quantitative health- or risk-based restrictions that limit exposure to types of hazardous substances and restrictions upon activities in certain locations.

Administrative requirements are those mechanisms that facilitate the implementation of the substantive requirements of a statute or regulation. Administrative requirements include the approval of administrative bodies, consultation, issuance of permits, documentation, reporting, recordkeeping, and enforcement.

WAIVERS

CERCLA Section 121 provides that under certain circumstances an otherwise applicable or relevant and appropriate requirement may be waived. These waivers apply only to the attainment of the ARAR; other statutory requirements, such as that remedies be protective of human health and the environment, cannot be waived. The waivers provided by CERCLA Section 1 21(d)(4) follow.

(1) **Interim Remedy**

The remedial action selected is only part of a total remedial action that will attain such level or standard of control when completed.

(2) **Greater Risk to Human Health or the Environment**

Compliance with the requirement at the site will result in greater risk to human health and the environment than alternative options.

(3) **Technical Impracticability**

Compliance with the requirement is technically impracticable from an engineering perspective.

(4) **Equivalent Standard of Performance**

The remedial action selected will attain a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, criteria, or limitation through use of another method or approach.

(5) **Inconsistent Application of State Requirements**

With respect to a state standard, requirement, criteria, or limitation, the state has not consistently applied (or demonstrated the intention to apply consistently) the standard, requirement, criteria, or limitation in similar circumstances at other remedial actions.

(6) Fund Balancing

In the case of a remedial action to be undertaken solely under Section 104 using the Fund, selection of a remedial action that attains the level or standard of control in the requirement will not provide a balance between the need for protection of public health and welfare and the environment at the site under consideration, and the availability of amounts from the Fund to respond to other sites that present or may present a threat to public health or welfare or the environment, taking into consideration the relative immediacy of such threats.

ARARs CATEGORIES

ARARs have been divided into three categories:

- Chemical-specific ARARs
- Location-specific ARARs
- Action-specific ARARs

These terms are described below.

Chemical-specific ARARs. These include those laws and requirements that regulate the release to the environment of materials possessing certain chemical or physical characteristics, or containing specified chemical compounds. These requirements generally set health or risk-based concentration limits or discharge limitations for specific hazardous substances. If, in a specific situation, a chemical is subject to more than one discharge or exposure limit, the more stringent of the requirements should generally be applied.

Location-specific ARARs. These relate to the geographical or physical position of the site, rather than the nature of the contaminants or the proposed site remedial actions. These requirements may limit the type of remedial actions that can be implemented, and may impose additional constraints on the cleanup action. Flood plain restrictions and the protection of endangered species are among the location-specific potential ARARs.

Action-specific ARARs. These define acceptable treatment and disposal procedures for hazardous substances. These ARARs generally set performance, design, or other similar action-specific controls or restrictions on particular kinds of activities related to management of hazardous substances or pollutants. These requirements are triggered by the particular remedial activities that are selected to accomplish a remedy. The action-specific requirements do not in themselves determine the remedial alternative; rather, they indicate how a selected alternative must be achieved.

Table C-1 (at the end of this appendix) lists action-specific ARARs that have been preliminarily identified for the Vertac off-site area.

GENERAL REQUIREMENTS

In addition to the requirements discussed in the text for each alternative, there are a number of regulations or requirements that are not related to a particular remedial action, and do not fit the description of a chemical-,action-, or location-specific ARAR, but may be considered applicable or relevant and appropriate to several potential remedial actions. These potential ARARs should be evaluated during the selection and design of remedial alternatives for the Vertac off-site area.

GROUNDWATER PROTECTION (40 CFR 264 SUBPART F)

Subpart F addresses releases from hazardous waste management units. The requirements include a groundwater monitoring program designed to detect releases from the hazardous waste treatment, storage, or disposal unit. The number of monitoring wells, sampling parameters, and groundwater concentration limits are determined for each individual unit.

Although groundwater was excluded from the scope of this study, the requirements of Subpart F would be applicable to the construction of hazardous waste management units in the Vertac off-site area. An overall site groundwater monitoring system, rather than monitoring systems for individual management units, would probably be acceptable.

CLEAN AIR ACT (40 CFR 50-99)

The Clean Air Act (CAA) has been implemented through a series of regulations (40 CFR 50-99) that define the air quality management programs used to achieve the CAA goals. These regulations, which are described below, fall into two groups: the definition of ambient air quality and air pollution source emission control and permitting. The first regulation described (National Primary and Secondary Ambient Air Quality Standards) defines air quality. The last three (Prevention of Significant Deterioration, Standards of Performance for New Stationary Sources, and National Emission Standards for Hazardous Air Pollutants) concern emission control and permitting.

National Primary and Secondary Ambient Air Quality Standards (40 CFR 50)

Primary and secondary standards are established for criteria pollutants. These pollutants include particulate matter, sulfur dioxide, nitrogen dioxide, ozone, carbon monoxide, and lead. Primary standards have been established for these pollutants based on health requirements. Secondary standards are intended to address aesthetic considerations. All of the standards are concentration based with a variety of averaging times. Ambient air quality sampling is performed in accordance with the prescribed EPA methods.

If an air quality management area or region fails to meet the primary standards, it is classified as a nonattainment area. Each state is responsible for preparation of a State Implementation Plan (SIP), which describes how the air quality programs will be implemented to achieve compliance with the primary standards. Upon meeting the primary standards, the area would be classified as "in attainment." The SIP must also identify how the programs will maintain attainment status for each of the primary pollutants. States that receive EPA approval for their SIP are allowed to manage their own programs with minimal EPA oversight. Proposed actions at CERCLA sites located in nonattainment areas will receive rigorous critical review if criteria pollutants are involved. Jacksonville, Arkansas, is in an attainment area.

Prevention of Significant Deterioration (40 CFR 52)

The Prevention of Significant Deterioration (PSD) program is a starting point for the SIP. Each proposed air pollution source must be reviewed to determine applicability under the PSD program. Applicability is determined by the source type and the total annual emissions of criteria pollutants. If a PSD permit is required, varying levels of air pollution control may be necessary. Collection of up to a year's worth of ambient air quality data may also be required. The PSD permitting program is established in a decision tree framework where certain criteria can trigger a variety of requirements. Standards are based on the location of a source, as well as the type and size of the unit.

Standards of Performance for New Stationary Sources (40 CFR 60)

The source standard program is commonly referred to as the New Source Performance Standards (NSPS). These standards have been established for specific source categories with additional capacity definitions to establish applicability. The NSPS rules establish both emission limitations and monitoring/reporting requirements. For every emission standard established, a published reference method is provided. It is important to note that sources requiring PSD permits may have emission limits lower than those established under the NSPS program. These lower limits may be required to meet the PSD program objectives. The NSPS standards only establish the maximum acceptable emission levels. 026110

National Emission Standards for Hazardous Air Pollutants (NESHAPS) (40 CFR 61)

The NESHAP program identifies specific source classifications that are regulated and specific compounds/emission levels that are allowed. The NESHAP regulations currently address arsenic, asbestos, benzene, beryllium, mercury, radionuclides, and vinyl chloride. Ambient air quality standards have not been established for these pollutants. However, EPA believes they are a health threat warranting regulation.

STANDARDS FOR TRANSPORTATION OF HAZARDOUS WASTE (40 CFR 263, 49 CFR)

These standards are applicable to wastes that are transported off-site. The transportation standards define the types of containers, labeling, and handling required for shipment of hazardous wastes or regulated materials over public roads or by common carriers. For remedial alternatives that include off-site disposal of wastes, treatment system effluents or residues, or other contaminated materials (Alternatives 3, 4, and 5, 6a, 6b), these requirements will be applicable. Any action or waste management occurring offsite is subject to full regulation under federal, state, and local law.

CLASSIFICATION OF VERTAC OFF-SITE WASTES

There are two classes of hazardous wastes defined under RCRA.

- **Characteristic hazardous wastes** exhibit one or more of four characteristics: toxicity, reactivity, corrosivity, or ignitability.

- **Listed hazardous wastes** include wastes that originate from specific industrial processes or sources, and wastes that are specific products, chemical intermediates, or Off-specification wastes from the manufacture of listed products (40 CFR 261).

The hazardous wastes included in the scope of this study are from the group of listed hazardous wastes referred to as the "dioxin wastes." The dioxin waste group includes the wastes identified as F020-023, and F026-027. Specifically, the waste from which the contamination in the Vertac off-site area originated is F020 waste from the production or manufacturing use of tri- or tetrachlorophenol, or of intermediates used to produce their pesticide derivatives.

Wastes that are part of a permitted discharge to a publicly-owned treatment plant (POTW) are regulated under the Clean Water Act, and are exempt from regulation under RCRA as long as the waste remains in place. However, if any hazardous wastes are removed and taken off-site of the POTW, then RCRA, including the land disposal restrictions (LDRs), becomes an ARAR. Wastes that entered Rocky Branch Creek directly from the Vertac plant in unpermitted discharges are subject to RCRA

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regulation as listed wastes. RCRA is applicable to some of the wastes, relevant and appropriate to some of the exempt wastes, and is relevant but not appropriate to other wastes. This is discussed later in this appendix.

Regulation of listed hazardous waste includes management of nonwaste materials contaminated by listed hazardous waste. Although soil is not considered a solid waste (and thus could not normally be considered a hazardous waste), soil contaminated with a listed hazardous waste is considered, from a RCRA regulatory perspective, to be the listed waste. Therefore, some of the contaminated soils on the Vertac Superfund site located off the plant site area are considered to be F020 listed hazardous waste.

The dioxin group wastes are also subject to regulation under the RCRA LDRs. The LDRs prohibit disposal of restricted wastes in land-based units (including landfills, surface impoundments, waste piles, and deep injection wells) unless the wastes have been treated to specified standards. Following treatment, the restricted wastes (actually the residue from the treatment of the restricted wastes) can be land-disposed in RCRA hazardous waste disposal units. The treatment standard for the dioxin group wastes is 1 ppb in the extract as determined by the TCLP.

In determining whether the LDRs are applicable or relevant and appropriate, it is necessary that the response actions constitute "placement" of wastes into a land disposal unit. For response actions under CERCLA, "placement" does not occur when wastes are moved within a single area of contamination. An area of contamination consisting of continuous contamination at a CERCLA site is analogous to a RCRA land disposal unit (See 55 FR 8758, March 8, 1990). As explained in the EPA Office of Solid Waste and Emergency Response (OSWER) Directive 9347.3-05FS, dated July 1989: "An area of contamination is delineated by the areal extent of contiguous contamination." The OSWER Directive cited above is an example of creek sediments being brought back to the contamination source without placement having occurred, and thus LDR portions of RCRA are not applicable.

Classification of the individual wastes or areas of contamination included in this study is dependent on RCRA. The following discusses the classification and clean-up recommendations.

SEWER LINES

Pipe and Sediment

Wastes entered the collection lines as part of a permitted discharge to a POTW. As noted previously, this discharge is regulated under the Clean Water Act and is exempt from RCRA as long as the wastes remain in place. EPA has decided that RCRA hazardous waste management requirements would be applicable to the management of any contaminated sediment, soil, or pipe debris removed or excavated. These materials would be managed to meet RCRA requirements. Because of the concentrations found in the pipe sediments, incinerating in a RCRA Subtitle C incinerator or equivalent is required. If the concentration of dioxin in the treatment residue ash leachate is less than 1 ppb, as determined by the TCLP, the residue can then be land disposed in an approved RCRA Subtitle C land disposal facility.

The April 24, 1986, ATSDR memo included a recommendation to "prevent human exposure to sludges, wastes, and sediments containing 2,3,7,8-TCDD and other contaminants of concern in the affected sanitary sewer and/or storm sewer collection system (abandoned and existing)." This is an important To Be Considered advisory.

Flushing Water

The water used for flushing sediments from the sewer lines is not strictly classified as hazardous waste, but could contain the listed dioxin wastes to make management requirements under RCRA Subtitle C relevant and appropriate. While there are no ARARs (promulgated standards) for dioxin in surface water or drinking water. There are a number of advisories for human health and protection of aquatic life. The May 1, 1986, Quality Criteria for Water includes an advisory for the protection of human health at the cancer risk level of $1x10^{-6}$, which is a concentration of $1.3x10^{-8}$ ppb dioxin in water. The same document includes advisories for the protection of aquatic life that range from 0.04 ppb to $1x10^{-5}$ ppb, depending on the species examined. The lower concentrations can not be achieved through treatment, nor can they be accurately measured. However, this wastewater would be treated using activated carbon. This would meet accepted treatment requirements.

OLD SEWAGE TREATMENT PLANT AND WEST WASTEWATER TREATMENT PLANT

Domestic wastewaters and nonresidential wastewaters that are permitted discharges to a POTW are not regulated under RCRA, as discussed above for the collection lines. However, if contaminated materials are removed from the plants, then RCRA, including the LDRs, are considered relevant and appropriate. This is based upon the reasons presented earlier for the sewer line pipe, sediments, and soils. If, for example, the digester sludge is excavated and removed from the Old Sewage Treatment Plant, then placement of the sludge would occur and the sludge should be managed according to RCRA, including the LDRs. If, on the other hand, the treatment units are demolished to facilitate capping of the contaminants in place, then placement will not occur and the LDRs are not relevant and appropriate. This is also supported by OSWER Directive 9347.3-05FS, dated July 1989.

Water collected from these units would be subject to the same treatment requirements specified earlier for the flushing water from the sewage lines.

The April 24, 1986, ATSDR memo recommended that exposure of the general public to contaminated sludges, wastes, soils, and sediments at the Old Sewage Treatment Plant (Old STP) be prevented. The report further recommended that contaminated materials in the wastewater facilities be prevented from contaminating off-site areas by migration through the sewer system or by wind or water erosion.

The ATSDR action level suggested for surface soils in the area of the Old STP is 5 to 7 ppb 2,3,7,8-TCDD. This action level presumes that the site will not be used for any activity "associated with the production, preparation, handling, consumption, or storage of food or other consumable items, and food packaging materials." In addition, "site soils must be protected from erosion that would uncover or transport 2,3,7,8-TCDD causing unacceptable human exposure at a future date."

The April 24, 1986, ATSDR memo included cleanup level recommendations for the West WWTP. The report recommended prevention of exposure of the general public to contaminated sludges, wastes, sediments, and soils. The potential for effluent discharges or surcharge releases to Bayou Meto of 2,3,7,8-TCDD contaminated materials from the oxidation lagoons and other components of the treatment system was also recommended.

The ATSDR memo also recommended an action level of not more than 5 to 7 ppb TCDD for areas on the existing WWTP that are zoned for manufacturing and that would be protected from erosion by surface runoff or potential flood event.

ROCKY BRANCH AND BAYOU METO FLOOD PLAIN

Soils and sediments contained in the Rocky Branch and Bayou Meto floodplains were contaminated by F020 waste that entered Rocky Branch Creek via runoff and discharges from the Vertac plant. Any soils and sediments that are contaminated by dioxin can be assumed to contain F020 waste and thus, if managed, must be done so according to RCRA.

However, if any of the floodplain soils or sediments that may be within the area of contamination discussed earlier are excavated and brought back to within the Vertac plant boundary, placement in the strictest sense may not occur, and the LDR portions of RCRA may not be applicable.

The April 24, 1986, ATSDR memo criteria for the Rocky Branch flood plains recommended that an action level of below 1 ppb 2,3,7,8-TCDD be achieved in surface soils and sediments located in existing residential yards, and in currently undeveloped lands zoned for residential use. The action level of 5 to 7 ppb was recommended for flood plain areas zoned for industrial or commercial use, with the conditions discussed for the old wastewater treatment plant.

DECONTAMINATION WASTE

The classification of decontamination wastes is dependent on the classification of the materials or wastes being washed from equipment, vehicles, personnel, etc. In other words, if a piece of equipment is contaminated by working with wastes, the decontamination wastewater and solids generated by cleaning the equipment will have the same classification as the waste.

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Table C-1
PRELIMINARY IDENTIFICATION OF POTENTIAL ACTION-SPECIFIC ARARs
VERTAC OFF-SITE FS

Actions[a]	Requirements	Prerequisites	Citation
Capping	Placement of a cap over waste (e.g., closing a landfill, or closing a surface impoundment or waste pile as a landfill, or similar action) requires a cover designed and constructed to: o Provide long-term minimization of migration of liquids through the capped area o Function with minimum maintenance o Promote drainage and minimize erosion or abrasion of the cover o Accommodate settling and subsidence so that the cover's integrity is maintained, and o Have a permeability less than or equal to the permeability of any bottom liner system or natural sub-soils present.	Significant management (treat ment, storage, or disposal) of hazardous waste will make re quirements applicable; capping without disturbance will not make requirements applicable, but technical requirements are likely to be relevant and appropriate.	40 CFR 264.228(a) (Surface Impoundments) 40 CFR 264.258(b) (Waste Piles) 40 CFR 264.310(a) (Landfills)
	Eliminate free liquids, stabilize wastes before capping (surface impoundments).		40 CFR 264.228(a)

[a]Action alternatives from ROD keyword index.

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Actions[a]	Requirements	Prerequisites	Citation
Capping (Continued)	Restrict post-closure use of property as necessary to prevent damage to the cover.		40 CFR 264.117(c)
	Prevent run-on and run-off from damaging cover.		40 CFR 264.228(b) 40 CFR 264.310(b)
	Protect and maintain surveyed benchmarks used to locate waste cells (landfills, waste piles).		40 CFR 264.310(b)
Clean Closure (Removal)	General performance standard requires minimization of need for further maintenance and control; minimization or elimination of post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products.	Disturbance of RCRA hazardous waste (listed or characteristic) and movement outside the unit or area of contamination. May apply to surface impoundment; contaminated soil, including soil from dredging or soil disturbed in the course of drilling, or excavation, and returned to land.	40 CFR 264.111
	Disposal or decontamination of equipment, structures, and soils.		40 CFR 264.111
	Removal or decontamination of all waste residues, contaminated containment system components (e.g., liners, dikes), contaminated subsoils, and structures and equipment contaminated with waste and leachate, and management of them as hazardous waste.	Not applicable to undisturbed material Disposal of RCRA hazardous waste (listed or characteristic) after disturbance and movement outside the unit or area of contamination.	40 CFR 264.228(a)(1) and 40 CFR 264.258
	Meet health-based levels at unit.		40 CFR 244.111

[a]Action alternatives from ROD keyword index.

Actions[a]	Requirements	Prerequisites	Citation
Closure with Waste in Place (Capping)	Eliminate free liquids by removal or solidification.		40 CFR 264.228(a)(2)
	Stabilization of remaining waste and waste residues to support cover.		40 CFR 264.228(a)(2) and 40 CFR 264.258(b)
	Installation of final cover to provide long-term minimization of infiltration.		40 CFR 264.310
	Post-closure care and ground-water monitoring.		40 CFR 264.310
Closure with Waste in Place (Hybrid Closure)	Removal of majority of contaminated materials.	Proposed rule, not yet applicable	52 FR 8712 (March 19, 1987)
	Application of cover and post-closure monitoring based on exposure pathway(s) of concern.	Proposed rule, not yet applicable	52 FR 8712 (March 19, 1987)
Consolidation	Area from which materials are removed should be cleaned up.	Disposal by disturbance of hazardous waste (listed or characteristic) and moving it outside unit or boundary of contaminated area.	See Closure
	Consolidation in storage piles/ storage tanks will trigger storage requirements.		See Container Storage, Tank Storage, Waste Piles in this Exhibit.
	Placement on or in land outside unit boundary or area of contamination will trigger land disposal requirements and restrictions.	After November 8, 1988	40 CFR 286 (Subpart D)

[a] Action alternatives from ROD keyword index.

Actions[a]	Requirements	Prerequisites	Citation
Container Storage (Onsite)	Containers of hazardous waste must be:	RCRA hazardous waste (listed or characteristic) held for a temporary period before treatment, disposal, or storage elsewhere, (40 CFR 264.10) in a container (i.e., any portable device in which a material is stored, transported, disposed of, or handled).	
	o Maintained in good condition		40 CFR 264.171
	o Compatible with hazardous waste to be stored		40 CFR 264.172
	o Closed during storage (except to add or remove waste)		40 CFR 264.173
	Inspect container storage areas weekly for deterioration.		40 CFR 264.174
	Place containers on a sloped, crack-free base, and protect from contact with accumulated liquid. Provide containment system with a capacity of 10 percent of the volume of containers of free liquids. Remove spilled or leaked waste in a timely manner to prevent overflow of the containment system.		40 CFR 264.175
	Keep containers of ignitable or reactive waste at least 50 feet from the facility's property line.		40 CFR 264.176
	Keep incompatible materials separate. Separate incompatible materials stored near each other by a dike or other barrier.		40 CFR 264.177

[a] Action alternatives from ROD keyword index.

Actions[a]	Requirements	Prerequisites	Citation
Container Storage (Onsite) (Continued)	At closure, remove all hazardous waste and residues from the containment system, and decontaminate or remove all containers, liners.		40 CFR 264.178
Containment (Construction of New Landfill Onsite) (See Closure with Waste in Place.)	Install two liners or more, a top liner that prevents waste migration into the liner, and a bottom liner that prevents waste migration through the liner.	RCRA hazardous waste (listed or characteristic) currently being placed in a landfill.	40 CFR 264.301
	Install leachate collection systems above and between the liners.		40 CFR 264.301
	Construct run-on and run-off control systems capable of handling the peak discharge of a 25-year storm.		40 CFR 264.301
	Control wind dispersal of particulates.		40 CFR 264.301
	Inspect liners and covers during and after installation.		40 CFR 264.303
	Provide groundwater monitoring adequate to detect releases from the unit.		40 CFR 264 Subpart F
	Inspect facility weekly and after storms to detect malfunction of control systems or the presence of liquids in the leachate collection and leak detection systems.		40 CFR 264.303

[a]Action alternatives from ROD keyword index.

Actions[a]	Requirements	Prerequisites	Citation
Containment (Construction of New Landfill Onsite) (See Closure with Waste in Place.) (Continued)	Maintain records of the exact location, dimensions, and contents of waste cells.		40 CFR 264.304
	Close each cell with a final cover after the last waste has been received.		40 CFR 264.310
	No bulk or non-containerized liquid hazardous waste or hazardous waste containing free liquids may be disposed of in landfills.		40 CFR 264.314
	Containers holding free liquids may not be placed in a landfill unless the liquid is mixed with an absorbent or solidified.		40 CFR 264.314
	Treatment by Best Demonstrated Available Technology before placement.	Placement, after November 8, 1988, of RCRA hazardous waste subject to land disposal restrictions.	40 CFR 268 (Subpart D)
Containment (Construction of New Surface Impoundment Onsite) (See Closure with Waste in Place and Clean Closure.)	Use two liners, a top liner that prevents waste migration into the liner and a bottom liner that prevents waste migration through the liner throughout the post-closure period.	RCRA hazardous waste (listed or characteristic) currently being placed in a surface impoundment.	40 CFR 264.220
	Design liners to prevent failure due to pressure gradients, contact with the waste, climatic conditions, and the stress of installation and daily operations		40 CFR 264.221

[a]Action alternatives from ROD keyword index.

Actions[a]	Requirements	Prerequisites	Citation
Containment (Construction of New Surface Impoundment Onsite) (See Closure with Waste in Place and Clean Closure.) (Continued)	Provide leachate collection system between the two liners.		40 CFR 264.221
	Use leak detection system that will detect leaks at the earliest possible time.		40 CFR 264.221
	Provide groundwater monitoring adequate to detect releases from the unit.		40 CFR 264 Subpart F
Dike Stabilization	Design and operate facility to prevent overtopping due to overfilling; wind and wave action; rainfall; run-on; malfunctions of level controllers, alarms, and other equipment; and human error.	Existing surface impoundments containing hazardous waste or creation of new surface impoundments.	40 CFR 264.221
	Construct dikes with sufficient strength to prevent massive failure.		40 CFR 264.221
	Inspect liners and cover systems during and after construction.		40 CFR 264.226
	Inspect weekly for proper operation and integrity of the containment devices.		40 CFR 264.226
	Provide groundwater monitoring adequate to detect releases from the unit.		40 CFR 264 Subpart F
	Remove surface impoundment from operation if the dike leaks or there is a sudden drop in liquid level.		40 CFR 264.227

[a]Action alternatives from ROD keyword index.

Actions[a]	Requirements	Prerequisites	Citation
Dike Stabilization (Continued)	At closure, remove or decontaminate all waste residues and contaminated materials. Otherwise, free liquids must be removed, the remaining wastes stabilized, and the facility closed in the same manner as a landfill.		40 CFR 264.228
	Manage ignitable or reactive waste so that it is protected from materials or conditions that may cause it to ignite or react.		40 CFR 264.227
Direct discharge of treatment system effluent	Applicable federal water quality criteria for the protection of aquatic life must be complied with when environmental factors are being considered.	Surface discharge of treated effluent.	50 FR 30784 (July 29, 1985)
	Applicable federally approved state water quality standards must be complied with. These standards may be in addition to or more stringent than other federal standards under the CWA.	Surface discharge of treated effluent.	40 CFR 122.44 and state regulations approved under 40 CFR 131
	The discharge must be consistent with the requirements of a Water Quality Management plan approved by EPA under Section 208(b) of the Clean Water Act.		

[a] Action alternatives from ROD keyword index.

Actions[a]	Requirements	Prerequisites	Citation
Direct discharge of treatment system effluent (Continued)	Use of best available technology (BAT) economically achievable is required to control toxic and nonconventional pollutants. Use of best conventional pollutant control technology (BCT) is required to control conventional pollutants. Technology-based limitations may be determined on a case-by-case basis.	Surface discharge of treated effluent	40 CFR 122.44(a)
	The discharge must conform to applicable water quality requirements when the discharge affects a state other than the certifying state.	Surface water discharge affecting waters outside Colorado	40 CFR 122.44(d)(4)
	Discharge limitations must be established for all toxic pollutants that are or may be discharged at levels greater than those which can be achieved by technology-based standards.	Surface discharge of treated effluent	40 CFR 122.44(e)
	Discharge must be monitored to assure compliance. Discharge will monitor: o The mass of each pollutant o The volume of effluent o Frequency of discharge and other measurements as appropriate.	Surface discharge of treated effluent	40 CFR 122.44(i)

[a]Action alternatives from ROD keyword index.

Actions[a]	Requirements	Prerequisites	Citation
Direct discharge of treatment system effluent (Continued)	Approved test methods for waste constituents to be monitored must be followed. Detailed requirements for analytical procedures and quality controls are provided.		
	Permit application information must be submitted including a description of activities, listing of environmental permits, etc.		40 CFR 122.21
	Monitor and report results as required by permit (minimum of at least annually)		40 CFR 122.44(i)
	Comply with additional permit conditions such as: o Duty to mitigate any adverse effects of any discharge; and o Proper operation and maintenance of treatment systems.		40 CFR 122.41(i)
	Develop and implement a Best Management Practices (BMP) program and incorporate in the NPDES permit to prevent the release of toxic constituents to surface waters.	Surface water discharge	40 CFR 125.100
	The BMP program must:		40 CFR 125.104

[a]Action alternatives from ROD keyword index.

Actions[a]	Requirements	Prerequisites	Citation
Direct discharge of treatment system effluent (Continued)	o Establish specific procedures for the control of toxic and hazardous pollutant spills. o Include a prediction of direction, rate of flow, and total quantity of toxic pollutants where experience indicates a reasonable potential for equipment failure. o Assure proper management of solid and hazardous waste in accordance with regulations promulgated under RCRA		
	Sample preservation procedures, container materials, and maximum allowable holding times are prescribed.	Surface water discharge	40 CFR 136.1-136.4
Discharge to POTW[b]	Pollutants that pass-through the POTW without treatment, interfere with POTW operation, or contaminate POTW sludge are prohibited. Specific prohibitions preclude the discharge of pollutants to POTWs that: o Create a fire or explosion hazard in the POTW o Are corrosive (pH<5.0)		40 CFR 403.5

[a]Action alternatives from ROD keyword index.

[b]Same regulations apply regardless of whether remedial action discharges into the sewer or trucks waste to an inlet to the sewage conveyance system located "upstream" of the POTW.

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Actions[a]	Requirements	Prerequisites	Citation
Discharge of dredge and fill material to navigable waters	The four conditions that must be satisfied before dredge and fill is an allowable alternative are: o There must be no practicable alternative o Discharge of dredged or fill material must not cause a violation of State water quality standards, violate any applicable toxic effluent standards, jeopardize an endangered species, or injure a marine sanctuary o No discharge shall be permitted that will cause or contribute to significant degradation of the water o Appropriate steps to minimize adverse effects must be taken Determine long- and short-term effects on physical, chemical, and biological components of the aquatic ecosystem.		40 CFR 230.10 33 CFR 320-330
Dredging	Removal of all contaminated soil.	Disposal by disturbance of hazardous waste and moving it outside the unit or area of contamination.	See discussions under Clean Closure, Consolidation, Capping
Excavation	Area from which materials are excavated may require cleanup to levels established by closure requirements	Disposal by disturbance of hazardous waste and moving it outside the unit or area of contamination.	40 CFR 264 Disposal and Closure requirements

[a] Action alternatives from ROD keyword index.

Actions[a]	Requirements	Prerequisites	Citation
Excavation (Continued)	Movement of excavated materials to a previously uncontaminated, onsite location, and placement in or on land may trigger land disposal restrictions.	Materials containing RCRA hazardous wastes subject to land disposal restrictions.	40 CFR 268 (Subpart D)
Gas Collection	Proposed standards for control of emissions of volatile organics (CAA requirements to be provided.)	Proposed standard; not yet ARAR.	52 FR 3748 (February 5, 1987)
Groundwater Diversion	Excavation of soil for construction of slurry wall may trigger cleanup or land disposal restrictions.	Disposal by disturbance of hazardous waste and moving it outside the unit or area of contamination.	See Consolidation, Excavation in this Exhibit.
Incineration (Onsite)	Analyze the waste feed.	RCRA hazardous waste.	40 CFR 264.341
	Dispose of all hazardous waste and residues, including ash, scrubber water, and scrubber sludge.		40 CFR 264.351

[a]Action alternatives from ROD keyword index.

Actions[a]	Requirements	Prerequisites	Citation
Incineration (Onsite) (Continued)	No further requirements apply to incinerators that only burn wastes listed as hazardous solely by virtue of the characteristic of ignitability, corrosivity, or both; or the characteristic of reactivity if the wastes will not be burned when other hazardous wastes are present in the combustion zone; and if the waste analysis shows that the wastes contain none of the hazardous constituents listed in Appendix VIII which might reasonably be expected to be present.		40 CFR 264.340
	Performance standards for incinerators:		
	o Achieve a destruction and removal efficiency of 99.99 percent for each principal organic hazardous constituent in the waste feed and 99.9999 percent for dioxins		40 CFR 264.343
	o Reduce hydrogen chloride emissions to 1.8 kg/hr or 1 percent of the HCl in the stack gases before entering any pollution control devices		40 CFR 264.342

[a]Action alternatives from ROD keyword index.

Actions[a]	Requirements	Prerequisites	Citation
Incineration (Onsite) (Continued)	Monitoring of various parameters during operation of the incinerator is required. These parameters include: o Combustion temperature o Waste feed rate o An indicator of combustion gas velocity o Carbon monoxide		40 CFR 264.343
	Special performance standard for incineration of PCBs.		40 CFR 761.70
Land Treatment	Ensure that hazardous constituents are degraded, transformed, or immobilized within the treatment zone.	RCRA hazardous waste.	40 CFR 264.271
	Maximum depth of treatment zone must be no more than 1.5 meters (5 feet) from the initial soil surface; and more than 1 meter (3 feet) above the seasonal high water table.		40 CFR 264.271
	Demonstrate that hazardous constituents for each waste can be completely degraded, transformed, or immobilized in the treatment zone.		40 CFR 264.272
	Minimize run-off of hazardous constituents.		40 CFR 264.273

[a]Action alternatives from ROD keyword index.

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Actions[a]	Requirements	Prerequisites	Citation
Land Treatment (Continued)	Maintain run-on/run-off control and management system.		40 CFR 264.273
	Special application conditions if food-chain crops grown in or on treatment zone.		40 CFR 264.276
	Unsaturated zone monitoring.		40 CFR264.278
	Provide groundwater monitoring adequate to detect releases from the unit.		40 CFR 264 Subpart F
	Special requirements for ignitable or reactive waste.		40 CFR 264.281
	Special requirements for incompatible wastes.		40 CFR 264.282
	Special requirements for RCRA hazardous wastes.		40 CFR 264.283
	Design system to operate odor free.		CAA Section 101[c] and 40 CFR 52[c]
Operation and Maintenance (O&M)	Post-closure care to ensure that site is maintained and monitored.		40 CFR 264.1
Slurry Wall	Excavation of soil for construction of slurry wall may trigger cleanup or land disposal restrictions.	Disposal by disturbance of hazardous waste and moving it outside the unit or area of contamination.	See Consolidation, Excavation in this Exhibit.

[a] Action alternatives from ROD keyword index.

[c] All of the Clean Air Act ARARs that have been established by the federal government are covered by matching state regulations. The state has the authority to manage these programs through the approval of its implementation plans (40 CFR 52 Subpart G).

Actions[a]	Requirements	Prerequisites	Citation
Surface Water Control	Prevent run-on and control and collect runoff from a 24-hour, 25-year storm (waste piles, land treatment facilities, landfills).	Land-based treatment, storage, or disposal units.	40 CFR 264.251(c)(d) 40 CFR 264.273(c)(d) 40 CFR 264.301(c)(d)
	Prevent over-topping of surface impoundment.		40 CFR 264.221(c)
Tank Storage (Onsite)	Tanks must have sufficient shell strength (thickness), and, for closed tanks, pressure controls, to assure that they do not collapse or rupture.	RCRA hazardous waste (listed or characteristic) held temporarily in a tank before treatment, disposal, or storage (40 CFR 264.10).	40 CFR 264.191
	Waste must not be incompatible with the tank material unless the tank is protected by a liner or by other means.		40 CFR 264.192
	Tanks must be provided with secondary containment to prevent releases.		40 CFR 264.193
	Tanks must be provided with controls to prevent overfilling and sufficient freeboard maintained in open tanks to prevent overtopping by wave action or precipitation.		40 CFR 264.194

[a] Action alternatives from ROD keyword index.

Actions[a]	Requirements	Prerequisites	Citation
Tank Storage (Onsite) (Continued)	Inspect the following: overfilling control, control equipment, monitoring data, waste level (for uncovered tanks), tank condition, above-ground portions of tanks (to assess their structural integrity), and the area surrounding the tank (to identify signs of leakage).		40 CFR 264.195
	Repair any corrosion, crack, or leak.		40 CFR 264.196
	At closure, remove all hazardous waste and hazardous waste residues from tanks, discharge control equipment, and discharge confinement structures.		40 CFR 264.197
	Store ignitable and reactive waste so as to prevent the waste from igniting or reacting. Ignitable or reactive wastes in covered tanks must comply with buffer zone requirements in "Flammable and Combustible Liquids Code," Tables 2-1 through 2-6 (National Fire Protection Association, 1976 or 1981).		40 CFR 264.198

[a]Action alternatives from ROD keyword index.

Actions[a]	Requirements	Prerequisites	Citation
Treatment	Standards for miscellaneous units (long-term retrievable storage, thermal treatment other than incinerators, open burning, open detonation, chemical, physical, and biological treatment units using other than tanks, surface impoundments, or land treatment units) require new miscellaneous units to satisfy environmental performance standards by protection of groundwater, surface water, and air quality, and by limiting surface and subsurface migration.	Treatment of hazardous wastes in units not regulated elsewhere under RCRA.	40 CFR 264 (Subpart X)
	Treatment of wastes subject to ban on land disposal must attain levels achievable by best demonstrated available treatment technologies (BDAT) for each hazardous constituent in each listed waste.	Effective date for CERCLA actions November 8, 1988, for F001-F005 hazardous wastes, dioxin wastes, and certain "California List" wastes. Other restricted wastes will have different effective dates as to be promulgated in 40 CFR 268.	40 CFR 268 (Subpart D)
	BDAT standards are based on one of four technologies or combinations: for wastewaters (1) steam stripping, (2) biological treatment, or (3) carbon absorption (alone or in combination with (1) or (2), and for all other wastes (4) incineration. Any technology may be used, however, if it will achieve the concentration levels specified.		

[a] Action alternatives from ROD keyword index.

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Actions[a]	Requirements	Prerequisites	Citation
Waste Pile	Use liner and leachate collection and removal system.	RCRA hazardous waste, noncontainerized accumulation of solid, nonflammable hazardous waste that is used for treatment or storage.	40 CFR 264.251

[a]Action alternatives from ROD keyword index.

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Appendix D

Detailed Analysis of Estimated Costs of Each Alternative

Appendix D

DETAILED ANALYSIS OF ESTIMATED COSTS OF EACH ALTERNATIVE

Tables D-1 through D-6 (at the end of this appendix) present order-of-magnitude cost estimates for Alternatives 2 through 6. The American Association of Cost Engineers (AACE) defines order-of-magnitude cost estimates as:

> An approximate estimate made without detailed engineering data. Some examples would be: an estimate from cost capacity curves, an estimate using scaleup or down factors, and an approximate ratio estimate. It is normally expected that an estimate of this type would be accurate within plus 50 percent to minus 30 percent for the stated scope.

This appendix presents separate costs for each alternative for capital costs, operating and maintenance (O&M) costs, and 30-year present value costs. Use of the 30-year length-of-operation period calculations were based on guidance in EPA's October 1988 *Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*.

The remediation costs were based on site information and cleanup requirements available at the time of the estimate (June 1989). Where specific site parameters were not available, assumptions have been made as needed.

FACTORS AFFECTING FINAL COSTS

The final costs of the project will depend upon a variety of factors: actual labor and material costs, actual contaminant volumes, site conditions, cleanup criteria, final project scope, final project schedule, competitive market conditions, and the contractor selected for remediation. Without careful consideration of all cost determinants, the estimate should not be considered as representative of any other remediation scenarios. Changes in any scope parameters will result in corresponding cost changes. Because of these factors, funding must be carefully reviewed prior to making specific financial decisions or establishing final budgets.

BID CONTINGENCIES

Bid contingencies are included to anticipate unknown costs associated with bidding the project. Factors that may affect project bidding include the nature of the hazardous waste risk and unfavorable market conditions for a particular project scope. Scope contingencies anticipate undefined costs commonly resulting from changes in project parameters. Scope contingencies typically are much higher for hazardous waste projects than for conventional engineering projects because of site and contamination uncertainties and effects of these uncertainties on costs.

The column in the cost tables entitled "Cost Extension" represents a separate tabulation of additional health-and-safety-related labor costs. The entry "INCL" means these costs have already been included in that line item. "NA" means the costs are not applicable to the item.

SENSITIVITY ANALYSES

Limited cost sensitivity analyses were performed for each alternative. All of the calculated sensitivity analysis cases resulted in 30-year present-value costs that stayed within a +50 percent to -30 percent cost range for each alternative. Key factors considered were:

- -30 percent to +50 percent variance in the volume of materials for incineration

- A 90-day waiting period from the completion of trial incineration burn to approval for incineration

- -30 percent to +50 percent variance in annual O&M costs

- -30 percent to +30 percent variance in labor and materials for sewer repair, hydraulic flushing, and new sewer costs

- RCRA disposal facility at 250 miles

- Reasonable variations in cap thicknesses and material costs

More specific range information for key variables was not available for this analysis. If the actual scope of the project varies substantially from the assumed scope, actual costs could vary beyond the order-of-magnitude range of accuracy assumed for each alternative.

COST ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST ($)	SUBTOTAL COST ($)	COST EXTENSION	TOTAL COST ($)	COMMENTS
WEST WWTP							
Fence area	7500	LF	8.80	66000	0	66000	To restrict access and use around ox.ponds & aer.basins
Post warning signs	75	EA	32	2400	0	2400	Post signs 1 per 100 LF
				68400	0	$68,000	
ROCKY BRANCH - FLOOD PLAIN							
Exc/Bckfill soils w/ TCDD > 5ppb	400	CY	170.00	68000	INCL	68000	Grid 17 & 18 - undeveloped residential areas; prelim
				68000	0	$68,000	
SLUDGE DEWATERING							Incl.sewer sediment (10cy),digester sludge (890cy) Dewater sludge to 15% solids
Site preparation	1	LS	15000	15000	2100	17100	Clearing, utility connections
Dewatering operation	1	MO	31560	31560	15600	47160	Mobil plate and frame system
Pump water to water treatment	250000	GAL	0.02	5000	NA	5000	Electricity, analytical, operations
				51560	17700	$69,000	
WATER COLLECTION AND TREATMENT							Filtrate from dewatering; water from decontamination of personnel & equipment
Site preparation	1	LS	15000	15000	2100	17100	Clearing, utility connections
Operation	1	MO	31560	31560	3640	35200	Mobil sedimentation/filtration/carbon adsorption
Pump water to discharge	250000	GAL	0.02	5000	NA	5000	Electricity, analytical, operations
				51560	5740	$57,000	

VERTAC OFF-SITE FS COST ESTIMATE -- ALTERNATIVE 2

COST ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST ($)	SUBTOTAL COST ($)	COST EXTENSION	TOTAL COST ($)	COMMENTS
GENERAL							Some line items include various general costs as indicated
Mobilization, Demobilization, Bonding, And Insurance	1	LS	156989	156989	NA	156989	10% of alt. SUBTOTAL, excluding incin & this line
Community Relations	1	LS	10000	10000	NA	10000	Prepare and plan public meetings, press briefing
Health & Safety Preparations							Based on sum total of labor for lines items
Worker Physicals	18	EA	500	9000	NA	9000	where health and safety preparations not included
Worker Training - initial	9	EA	3200	28800	NA	28800	
- refresher	9	EA	1250	11250	NA	11250	
Site Health & Safety -- PPE							Based on totals of C or D labor for line items
Personal Protective Equipment - Level C	474	MD	40	18979	NA	18979	where health and safety preparations not included
Personal Protective Equipment - Level D	722	MD	20	14435	NA	14435	
Decontamination							
Decon Trailer	5	MO	1000	5000	NA	5000	Assume 1 decon trailer per crew of 5 in C/D
Vehicle Decontamination Station	1	LS	10000	10000	NA	10000	Temporary facility-HDPE on gravel,sump&pump,tank
Construction Administration Trailer	5	MO	270	1350	NA	1350	
Monitoring							
Background Air Monitoring	1	LS	50000	50000	NA	50000	High volume particulate sampling & analysis
Ambient Air Monitoring	3	MO	10000	30000	NA	30000	Ambient conditions & particulate monitoring (work areas)
				345803	0	$346,000	
COLLECTION LINES							
Repair exst sewer system (broken section	1	LS	466000	466000	INCL	466000	Assume 300 lf needs repair before flushing
Clean solids out of active sewer lines	1	LS	291000.00	291000	40740	331740	Hydraulic flushing, vacuuming, camera inspections
Maintain service of existing sewer system	1	LS	20000.00	20000	2800	22800	Temp sewer lines, pumping
Transport to solids dewatering	72000	GAL	0.02	1440	202	1642	7 gal/lf -- vacuum trucks, pumping
				778440	43742	$822,000	
OLD STP							
Vacuum sludge from digester	890	CY	85	75650	45390	121040	Assuming 5% solids
Transport to sludge dewatering	1	LS	6200	6200	INCL	6200	Transport in tanker trucks, demurrange
Decontaminate digester	1	LS	25000	25000	15000	40000	High pressure wash; treat residuals
Fence area	1500	LF	8.80	13200	NA	13200	To restrict access and use
Post warning signs	15	EA	32	480	NA	480	Post signs 1 per 100 LF
				120530	60390	$181,000	

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TABLE D-1

COST ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST ($)	SUBTOTAL COST ($)	COST EXTENSION	TOTAL COST ($)	COMMENTS
ANNUAL O&M COSTS							
Inspect and maintain fence and warning si	1	LS	1600	1600			
Cap maintenance							
First year	1	LS	5000	5000			
After first year	1	LS	3000	3000			
Misc monitoring	1	LS	5000	5000			
Administrative costs	1	LS	10000	10000			
Maintenance reserve and contingency co	1	LS	13000	13000			
(A2) TOTAL ANNUAL O&M				$35,000	(first year)		
				$33,000	(after first year)		
30 YEAR PRESENT WORTH COST =				$4,000,000			

LEGEND

Level D protective equipment = 1
Level C protective equipment = 2
NA - Not applicable

COST ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST ($)	SUBTOTAL COST ($)	COST EXTENSION	TOTAL COST ($)	COMMENTS
CONSOLIDATE SOLIDS ONSITE							Dewatered sludge, bagged soil, incinerator ash
Load/Haul/Unload	700	CY	5.00	3500	2100	5600	
Truck decontamination operations	58	EA	100.00	5800	812	6612	
Spreading fill with bulldozer	700	CY	2.00	1400	840	2240	
RCRA Cap	0.25	AC	400000	100000	INCL	100000	Includes 2 ft. clay and synthetic membrane layers
				110700	3752	$114,000	
INCINERATION							Dewatered sewer solids; excavated materials from sewer repa Spent carbon
Load/haul/unload	260	CY	5	1300	780	2080	
Incineration	299	TONS	2000	598000	INCL	598000	Site preparation, mobilization, trial burn, commissioning, operations, demobilization
				599300	780	$600,000	
(A2) SUBTOTAL				$2,194,293	$132,104	$2,330,000	
Bid contingencies (15% of Const. Subtotal)						$350,000	
Scope contingencies (25% of Const. Subtotal)						$583,000	
CONSTRUCTION TOTAL						$3,263,000	
Start-up (10% of dewatering and water treatment cost+ 5% of incineration costs)						$42,500	
Permitting and legal costs (3% of C.T.)						$98,000	
Service during const. (8% of C.T.)						$261,000	
Engineering and design (8% of C.T)						$261,000	
TOTAL IMPLEMENTATION COST						$663,000	
(A2) TOTAL CAPITAL COST						$3,900,000	

COST ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST ($)	SUBTOTAL COST ($)	COST EXTENSION	TOTAL COST ($)	COMMENTS
OLD STP							
Vacuum sludge from digester	890	CY	85	75650	45390	121040	Assuming 5% solids
Transport to sludge dewatering	1	LS	6200	6200	INCL	6200	Transport in tanker trucks, demurrange
Decontaminate digester	1	LS	25000	25000	15000	40000	High pressure wash; treat residuals
Asphalt cap sludge drying beds	0.74	AC	190000	140600	INCL	140600	prelim
Fence area	1500	LF	8.80	13200	0	13200	To restrict access and use
Post warning signs	15	EA	32	480	0	480	Post signs 1 per 100 LF
				261130	60390	$322,000	
WEST WWTP							
Construct berm around oxidation ponds	5800	LF	28.00	162400	22736	185136	Vegitated earthen berm(100-yr flood), ditch, modify outlet
Fence area	7500	LF	8.80	66000	0	66000	To restrict access and use around ox.ponds & aer.basins
Post warning signs	75	EA	32	2400	0	2400	Post signs 1 per 100 LF
				230800	22736	$254,000	
ROCKY BRANCH - FLOOD PLAIN							
Exc/Bckfill soils w/ TCDD > 5ppb	400	CY	170	68000	INCL	68000	Grid 17 & 18 - undeveloped residential areas; prelim
				68000	0	$68,000	
SLUDGE DEWATERING							Incl.sewer sediment (10cy),digester sludge (890cy)
							Dewater sludge to 15% solids
Site preparation	1	LS	15000	15000	2100	17100	Clearing, utility connections
Dewatering operation	1	MO	31560	31560	15600	47160	Mobil plate and frame system
Pump water to water treatment	250000	GAL	0.02	5000	NA	5000	Electricity, analytical, operations
				51560	17700	$69,000	

VERTAC OFF-SITE FS COST ESTIMATE -- ALTERNATIVE 3

COST ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST ($)	SUBTOTAL COST ($)	COST EXTENSION	TOTAL COST ($)	COMMENTS
GENERAL							Some line items include various general costs as indicated
Mobilization, Demobilization, Bonding, And Insurance	1	LS	284992	284992	NA	284992	10% of alt. SUBTOTAL, excluding this line item
Community Relations	1	LS	10000	10000	NA	10000	Prepare and plan public meetings, press briefing
Health & Safety Preparations							Based on sum total of labor for lines items
Worker Physicals	27	EA	500	13500	NA	13500	where health and safety preparations not included
Worker Training - initial	4	EA	3200	12800	NA	12800	
- refresher	4	EA	1250	5000	NA	5000	
Site Health & Safety -- PPE							Based on totals of C or D labor for line items
Personal Protective Equipment - Level C	517	MD	40	20673	NA	20673	where health and safety preparations not included
Personal Protective Equipment - Level D	1225	MD	20	24491	NA	24491	
Decontamination							
Decon Trailer	6	MO	1000	6000	NA	6000	
Vehicle Decontamination Station	1	LS	10000	10000	NA	10000	Temporary facility-HDPE on gravel,sump&pump,tank
Construction Administration Trailer	4	MO	270	1080	NA	1080	
Monitoring							
Background Air Monitoring	1	LS	50000	50000	NA	50000	High volume particulate sampling & analysis
Ambient Air Monitoring	6	MO	10000	60000	NA	60000	Ambient conditions & particulate monitoring (work areas)
				498537	0	$499,000	
COLLECTION LINES							
Repair exst sewer system (broken section	1	LS	466000	466000	INCL	466000	Assume 300 lf needs repair before flushing
Clean solids out of active sewer lines	1	LS	291000	291000	40740	331740	Hydraulic flushing, vacuuming, camera inspections
Maintain service of existing sewer system	1	LS	20000	20000	2800	22800	Temp sewer lines, pumping
Install pipe liners	10350	LF	100	1035000	NA	1035000	
Transport to solids dewatering	72000	GAL	0.02	1440	201.6	1642	7 gal/lf -- vacuum trucks, pumping
				1813440	43742	$1,900,000	

COST ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST ($)	SUBTOTAL COST ($)	COST EXTENSION	TOTAL COST ($)	COMMENTS
ANNUAL O&M COSTS							
Inspect and maintain fence and warning si	1	LS	1600.00	1600			
Berm inspections and maintenance							
First year	1	LS	20300	20300			
After first year	1	LS	4500	4500			
Maintain asphalt cap							
Every 5 years	1	LS	10000	10000			Inspection, fill cracks and slurry seal entire surface
Misc monitoring	1	LS	5000	5000			
Administrative costs	1	LS	10000	10000			
Maintenance reserve and contingency co	1	LS	24000	24000			
(A3) TOTAL ANNUAL O&M				$61,000	(first year)		
				$45,000	(after first year)		
				$10,000	(every fifth year)		
30 YEAR PRESENT WORTH COST =				$8,000,000			

LEGEND

Level D protective equipment = 1
Level C protective equipment = 2
NA - Not applicable

COST ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST ($)	SUBTOTAL COST ($)	COST EXTENSION	TOTAL COST ($)	COMMENTS
WATER COLLECTION AND TREATMENT							Filtrate from dewatering; water from decontamination of personnel & equipment
Site preparation	1	LS	15000	15000	2100	17100	Clearing, utility connections
Operation	1	MO	31560	31560	3640	35200	Mobil sedimentation/filtration/carbon adsorption
Pump water to discharge	250000	GAL	0.02	5000	NA	5000	Electricity, analytical, operations
				51560	5740	$57,000	
INCINERATION							Dewatered solids, bagged soils, additional residential soils Excavated materials from sewer repair; spent carbon
Load/haul/unload	960	CY	5.00	4800	2880	7680	
Incineration	1104	TONS	850	938400	INCL	938400	Site preparation, mobilization, trial burn, commissioning, operations, demobilization
Transport ash to RCRA landfill	1	LS	100000	100000	14000	114000	Assume 750 mi haul to off-site RCRA landfill
Ash disposal fees	1104	TONS	130	143520	INCL	143520	
Waste disposal tax	1104	TONS	27	29808	NA	29808	
Truck decontamination	110.4	EA	100	11040	6624	17664	
				1227568	23504	$1,250,000	
(A3) SUBTOTAL				$4,200,000	$200,000	$4,400,000	
Bid contingencies (20% of Const. Subtotal)						$880,000	
Scope contingencies (30% of Const. Subtotal)						$1,320,000	
CONSTRUCTION TOTAL						$6,600,000	
Start-up (10% of dewatering and water treatment cost+ 2% of incineration)						$31,000	
Permitting and legal costs (2% of C.T.)						$132,000	
Service during const. (6% of C.T.)						$396,000	
Engineering and design (6% of C.T)						$396,000	
TOTAL IMPLEMENTATION COST						$960,000	
(A3) TOTAL CAPITAL COST						$7,600,000	

COST ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST ($)	SUBTOTAL COST ($)	COST EXTENSION	TOTAL COST ($)	COMMENTS
OLD STP							
Vacuum sludge from digester	890	CY	85	75650	45390	121040	Assuming 5% solids
Transport to sludge dewatering	1	LS	6200	6200	INCL	6200	Transport in tanker trucks, demurrange
Decontaminate digester	1	LS	25000	25000	15000	40000	High pressure wash; treat residuals
Mechanically exc/bckfill sludge drying bed	1500	CY	60	90000	54000	144000	Incl.confirmation sampling & analytical
Fence area	1500	LF	8.80	13200	0	13200	To restrict access and use
Post warning signs	15	EA	32	480	0	480	Post signs 1 per 100 LF
				210530	114390	$325,000	
WEST WWTP							
Drain and/or pump water from aerat.basin	6800000	GAL	0.01	68000	9520	77520	Pump/Drain to ox. pond. Assume 7 ft of water
Cap drained aeration basin							Fill to grade with surrounding soil
Native fill	46000	CY	11	506000	70840	576840	
Topsoil	2400	CY	20	48000	NA	48000	
Sod	3	AC	12400	37200	NA	37200	
Construct berm around oxidation ponds	5800	LF	60.00	348000	48720	396720	To protect against the 100-yr flood
Fence area	7500	LF	8.80	66000	0	66000	To restrict access and use around ox.ponds & aer.basins
Post warning signs	75	EA	32	2400	0	2400	Post signs 1 per 100 LF
				1075600	129080	$1,200,000	
ROCKY BRANCH - FLOOD PLAIN							
Exc/Bckfill soils w/ TCDD > 1ppb	4100	CY	71.00	291100	INCL	291100	Grid 9,10,11,13,14,15,16,17,18 & Hercules property;prelim
				291100	0	$291,000	
SLUDGE DEWATERING							Incl.sewer sediment (10cy),digester sludge (890cy)
							Dewater sludge to 15% solids
Site preparation	1	LS	15000	15000	2100	17100	Clearing, utility connections
Dewatering operation	1	MO	31560	31560	18936	50496	Mobil plate and frame system
Pump water to water treatment	250000	GAL	0.02	5000	NA	5000	Electricity, analytical, operations
				51560	21036	$73,000	

VERTAC OFF-SITE FS COST ESTIMATE -- ALTERNATIVE 4

COST ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST ($)	SUBTOTAL COST ($)	COST EXTENSION	TOTAL COST ($)	COMMENTS
GENERAL							Some line items include various general costs as indicated
Mobilization, Demobilization, Bonding, And Insurance	1	LS	406417	406417	NA	406417	10% of alt. SUBTOTAL, excluding this line item
Community Relations	1	LS	10000	10000	NA	10000	Prepare and plan public meetings, press briefing
Health & Safety Preparations							Based on sum total of labor for lines items
Worker Physicals	29	EA	500	14500	NA	14500	where health and safety preparations not included
Worker Training - initial	14	EA	3200	44800	NA	44800	
- refresher	14	EA	1250	17500	NA	17500	
Site Health & Safety -- PPE							Based on totals of C or D labor for line items
Personal Protective Equipment - Level C	1348	MD	40	53901	NA	53901	where health and safety preparations not included
Personal Protective Equipment - Level D	4332	MD	20	86631	NA	86631	
Decontamination							
Decon Trailer	19	MO	1000	19000	NA	19000	
Vehicle Decontamination Station	1	LS	10000	10000	NA	10000	Temporary facility-HDPE on gravel,sump&pump,tank
Disposal of Contaminated Materials		Drums		0	NA	0	Disposable personal gear, solids from water treatment
Construction Administration Trailer	11	MO	270	2970		2970	
Monitoring					NA		
Background Air Monitoring	1	LS	50000	50000	NA	50000	High volume particulate sampling & analysis
Ambient Air Monitoring	6	MO	10000	60000	0	60000	Ambient conditions & particulate monitoring (work areas)
				775720	0	$776,000	
COLLECTION LINES							
Repair exst sewer system (broken section	1	LS	466000	466000	INCL	466000	Assume 300 lf needs repair before flushing
Clean solids out of active sewer lines	1	LS	291000	291000	40740	331740	Hydraulic flushing, vacuuming, camera inspections
Maintain service of existing sewer system	1	LS	20000	20000	2800	22800	Temp sewer lines, pumping
Install pipe liners	10350	LF	100	1035000	NA	1035000	
Transport to solids dewatering	72000	GAL	0.02	1440	202	1641.6	7 gal/lf -- vacuum trucks, pumping
Remove abandoned interceptor, backfill	1	LS	590000	590000	NA	590000	3200 cy contaminated matls go to incineration
				2403440	43742	$1,900,000	

COST ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST ($)	SUBTOTAL COST ($)	COST EXTENSION	TOTAL COST ($)	COMMENTS
ANNUAL O&M COSTS							
Inspect and maintain fence and warning si	1	LS	1600	1600			
Maintain aeration basin cap	1	LS					
First year	1	LS	22000	22000			
After first year	1	LS	11000	11000			
Inspect and maintain berms							
First year	1	LS	41500	41500			
After first year	1	LS	8700	8700			
Monitoring costs	1	LS	5000	5000			
Administrative costs	1	LS	10000	10000			
Maintenance reserve and contingency co	1	LS	32000	32000			
(A4) TOTAL ANNUAL O&M				$110,000	(first year)		
				$66,000	(after first year)		
30 YEAR PRESENT WORTH COST =				$21,000,000			

Level D protective equipment = 1

Level C protective equipment = 2

NA - Not applicable

COST ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST ($)	SUBTOTAL COST ($)	COST EXTENSION	TOTAL COST ($)	COMMENTS
WATER COLLECTION AND TREATMENT							Filtrate from dewatering; water from decontamination of personnel & equipment
Site preparation	1	LS	15000	15000	2100	17100	Clearing, utility connections
Operation	1	MO	31560	31560	4418	35978	Mobil sedimentation/filtration/carbon adsorption
Disposal of decontaminated fluids	250000	GAL	0.02	5000	NA	5000	Electricity, analytical, operations
				51560	6518	$58,000	
INCINERATION							Dewatered solids, bagged soils, additional residential soils Matls from sewer repair and old sewer removal;spent carbon
Load/haul/unload	9400	CY	5.00	47000	28200	75200	
Incineration	10810	TONS	390	4215900	NA	4215900	Site preparation, mobilization, trial burn, commissioning, operations, demobilization
Transport ash to RCRA landfill	1	LS	950000	950000	133000	1083000	Assume 750 mi haul to off-site RCRA landfill
Ash disposal fees	10810	TONS	130	1405300	NA	1405300	
Waste disposal tax	10810	TONS	27	291870	NA	291870	
Truck decontamination	1081	EA	100	108100	64860	172960	
				7018170	226060	$7,240,000	
(A4) SUBTOTAL				$11,877,680	$540,826	$11,900,000	
Bid contingencies (15% of Const. Subtotal)						$1,800,000	
Scope contingencies (25% of Const. Subtotal)						$3,600,000	
CONSTRUCTION TOTAL						$17,300,000	
Start-up (10% of dewatering and water treatment cost+)						$100,000	
Permitting and legal costs (2% of C.T.)						$346,000	
Service during const. (5% of C.T.)						$865,000	
Engineering and design (5% of C.T)						$865,000	
TOTAL IMPLEMENTATION COST						$2,200,000	
(A4) TOTAL CAPITAL COST						$20,000,000	

COST ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST ($)	SUBTOTAL COST ($)	COST EXTENSION	TOTAL COST ($)	COMMENTS
OLD STP							
Vacuum sludge from digester	890	CY	85	75650	45390	121040	Assuming 5% solids
Transport to sludge dewatering	1	LS	6200	6200	INCL	6200	Transport in tanker trucks, demurrange
Decontaminate digester	1	LS	25000	25000	15000	40000	High pressure wash; treat residuals
Mechanically exc/bckfill sludge drying bed	1500	CY	73	110000	INCL	110000	Incl confirmation sampling & analytical
Fence area	1525	LF	8.80	13420	1879	15299	To restrict access and use
Post warning signs	15	EA	32	480	67	547	Post signs 1 per 100 LF
Clean primary clarifiers	1	LS	35000	35000	4900	39900	High pressure wash; treat residuals
Remove sediments	90	CY	85	7650	1071	8721	Assuming 5% solids, vacuum removal
				273400	68307	$342,000	
WEST WWTP							
Drain and/or pump water from aeration ba	6800000	GAL	0.02	136000	19040	155040	Pump/Drain to ox. pond. Assume 7 ft of water
Pump sludge from bottom of basin	8000	CY	85	680000	408000	1088000	Assume 2 ft cont. sludge depth at 5% solids
Test bottom sed. of basin for TCDD>1ppb	1	LS	1000	1000	600	1600	If TCDD>1ppb, then further excavation is necessary
Pump water from oxidation ponds	30000000	GAL	0.02	600000	84000	684000	Assume 2 ft of water in ponds
Cap oxidation ponds							Cap ponds after pumping water out of ponds and drying
Native fill	178000	CY	11	1958000	274120	2232120	Buy, load, haul, spread, compact
Topsoil	36000	CY	20	720000	NA	720000	Buy, load, haul, spread, compact
Sod	44	AC	12400	545600	NA	545600	
Fence area	7500	LF	8.80	66000	9240	75240	To restrict access and use around ox.ponds & aer.basin
Post warning signs	75	EA	32	2400	336	2736	Post signs 1 per 100 LF
				4709000	795336	$5,500,000	
ROCKY BRANCH - FLOOD PLAIN							
Exc/Bckfill soils w/ TCDD > 1ppb	4100	CY	60	246000	147600	393600	Grid 9,10,11,13,14,15,16,17,18 & Hercules property
				246000	147600	$394,000	

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VERTAC OFF-SITE FS COST ESTIMATE -- ALTERNATIVE 5

COST ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST ($)	SUBTOTAL COST ($)	COST EXTENSION	TOTAL COST ($)	COMMENTS
GENERAL							Some line items include various general costs as indicated
Mobilization, Demobilization, Bonding, And Insurance	1	LS	972963	972963	NA	972963	10% of alt. SUBTOTAL, excluding this line item
Community Relations	1	LS	10000	10000	NA	10000	Prepare and plan public meetings, press briefing
Health & Safety Preparations							Based on sum total of labor for lines items
Worker Physicals	252	EA	500	126000	NA	126000	where health and safety preparations not included
Worker Training - inintial	124	EA	5000	620000	NA	620000	
- refresher	124	EA	1500	186000	NA	186000	
Site Health & Safety -- PPE							Based on totals of C or D labor for line items
Personal Protective Equipment - Level C	5765	MD	40	230596	NA	230596	where health and safety preparations not included
Personal Protective Equipment - Level D	10764	MD	20	215290	NA	215290	
Decontamination							
Decon Trailer	55	MO	1000	55000	NA	55000	
Vehicle Decontamination Station	1	LS	10000	10000	NA	10000	Temporary facility-HDPE on gravel,sump&pump,tank
Construction Administration Trailer	29	MO	270	7830	NA	7830	
Monitoring							
Background Air Monitoring	1	LS	50000	50000	NA	50000	High volume particulate sampling & analysis
Ambient Air Monitoring	9	MO	10000	90000	NA	90000	Ambient conditions & particulate monitoring (work areas)
				2573678	0	$2,600,000	
COLLECTION LINES							
Remove abandoned interceptor	1	LS	590000	590000	INCL	590000	
Remove Rocky Branch Interceptor Syste	1	LS	1200000	1200000	INCL	1200000	
Maintain Existing Sewer Service	1	LS	19932	19932	2790	22722	
New Rocky Branch Interceptor System	10350	LF	72	745200	104328	849528	
				2555132	107118	$2,660,000	

COST ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST ($)	SUBTOTAL COST ($)	COST EXTENSION	TOTAL COST ($)	COMMENTS
Start-up (10% of dewatering+water treatment; 2% incineration cost)						$136,000	
Permitting and legal costs (2% of C.T.)						$670,000	
Service during const. (5% of C.T.)						$1,680,000	
Engineering and design (5% of C.T)						$1,680,000	
TOTAL IMPLEMENTATION COST						$4,200,000	
(A5) TOTAL CAPITAL COST						$38,000,000	
O&M COSTS							
Inspect and maintain fence and warning si	1	LS	1900	1900			
Maintain oxidation ponds cap							
First year	1	LS	105000	105000			
After first year	1	LS	52466	52466			
Monitoring costs	1	LS	5000	5000			
Administrative costs	1	LS	1000	1000			
Maintenance reserve and contingency co	1	LS	84000	84000			
(A5) TOTAL ANNUAL O&M				$200,000	(first year)		
				$150,000	(after first year)		
30 YEAR PRESENT WORTH COST =				$40,000,000			

LEGEND

Level D protective equipment = 1
Level C protective equipment = 2
NA - Not applicable

VERTAC OFF-SITE FS COST ESTIMATE -- ALTERNATIVE 6a

COST ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST ($)	SUBTOTAL COST ($)	COST EXTENSION	TOTAL COST ($)	COMMENTS
GENERAL							Some line items include various general costs as indicated
Mobilization, Demobilization, Bonding, And Insurance	1	LS	723767	723767	NA	723767	10% of alt. SUBTOTAL, excluding incin & this line
Community Relations	1	LS	10000	10000	NA	10000	Prepare and plan public meetings, press briefing
Health & Safety Preparations							Based on sum total of labor for lines items
Worker Physicals	53	EA	500	26500	NA	26500	where health and safety preparations not included
Worker Training - initial	26	EA	3200	83200	NA	83200	
- refresher	26	EA	1250	32500	NA	32500	
Site Health & Safety -- PPE							Based on totals of C or D labor for line items
Personal Protective Equipment - Level C	446	MD	40	17843	NA	17843	where health and safety preparations not included
Personal Protective Equipment - Level D	3065	MD	20	61305	NA	61305	
Decontamination							
Decon Trailer	16	MO	1000	16000	NA	16000	Assume 1 decon trailer per crew of 5 in C/D
Vehicle Decontamination Station	1	LS	10000	10000	NA	10000	Temporary facility-HDPE on gravel,sump&pump,tank
Construction Administration Trailer	16	MO	270	4320	NA	4320	
Monitoring							
Background Air Monitoring	1	LS	50000	50000	NA	50000	High volume particulate sampling & analysis
Ambient Air Monitoring	3	MO	10000	30000	NA	30000	Ambient conditions & particulate monitoring (work areas)
				1065435	0	$1,065,000	
COLLECTION LINES							
Repair exst sewer system (broken section	1	LS	466000	466000	INCL	466000	Assume 300 lf needs repair before flushing
Clean solids out of active sewer lines	1	LS	291000.00	291000	40740	331740	Hydraulic flushing, vacuuming, camera inspections
Maintain service of existing sewer system	1	LS	20000.00	20000	2800	22800	Temp sewer lines, pumping
Install pipe liners	10350	LF	100	1035000	NA	1035000	
Grout abandoned interceptor	1	LS	18000	18000	NA	18000	Pump grout into manholes to fill interceptor lines
				1830000	43540	$1,874,000	

TABLE D-5

COST ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST ($)	SUBTOTAL COST ($)	COST EXTENSION	TOTAL COST ($)	COMMENTS
OLD STP							
Vacuum sludge from digester	890	CY	85	75650	45390	121040	Assuming 5% solids
Transport to sludge dewatering	1	LS	6200	6200	INCL	6200	Transport in tanker trucks, demurrange
Demolish digester, clarifiers, etc.	1	LS	470000	470000	65800	535800	Demolish all structures, bury in/over secondary clarifiers
Install 1 foot soil cover	1	LS	110000	110000	15400	125400	Cover sludge drying beds and secondary clarifier with soil
Fence area	1500	LF	8.80	13200	NA	13200	To restrict access and use
Post warning signs	15	EA	32	480	NA	480	Post signs 1 per 100 LF
				675530	126590	$802,000	
WEST WWTP							
Drain and/or pump water from aerat.basin	6800000	GAL	0.01	68000	9520	77520	Pump/Drain to ox. pond. Assume 7 ft of water
Cap drained aeration basin							Fill to grade with surrounding soil
Native fill	46000	CY	11	506000	70840	576840	
Topsoil	2400	CY	20	48000	NA	48000	
Sod	3	AC	12400	37200	NA	37200	
Fence area	7500	LF	8.80	66000	9240	75240	To restrict access and use around ox.ponds & aer.basins
Post warning signs	75	EA	32	2400	336	2736	Post signs 1 per 100 LF
				727600	89936	$818,000	
ROCKY BRANCH - FLOOD PLAIN							
Exc/Bckfill soils w/ TCDD > 1ppb	4100	CY	170.00	697000	INCL	697000	Grid 17 & 18 - undeveloped residential areas; prelim
				697000	0	$697,000	
SLUDGE DEWATERING							Incl.sewer sediment (10cy),digester sludge (890cy)
							Dewater sludge to 15% solids
Site preparation	1	LS	15000	15000	2100	17100	Clearing, utility connections
Dewatering operation	1	MO	31560	31560	15600	47160	Mobil plate and frame system
Pump water to water treatment	250000	GAL	0.02	5000	NA	5000	Electricity, analytical, operations
				51560	17700	$69,000	

COST ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST ($)	SUBTOTAL COST ($)	COST EXTENSION	TOTAL COST ($)	COMMENTS
SLUDGE DEWATERING							Incl.sewer sediment (10cy),digester sludge (890cy), and aer.basin sludge (8000cy) Dewater sludge to 15% solids
Site preparation	1	LS	15000	15000	2100	17100	Clearing, utility connections
Dewatering operation	2	MO	31560	63120	37872	100992	Mobil plate and frame system
Pump water to water treatment	1800000	GAL	0.02	36000	NA		Electricity, analytical, operations
				114120	39972	$118,000	
WATER COLLECTION AND TREATMENT							Filtrate from dewatering; water from decontamination of personnel and equipment; water from draining aer. basin & oxidation ponds
Site preparation	1	LS	22500	22500	3150	25650	Clearing, utility connections
Operation	2	MO	100000	200000	120000	320000	Mobil sedimentation/filtration/carbon adsorption
Pump water to discharge	37000000	GAL	0.01	370000	NA		Electricity, analytical, operations
				592500	123150	$346,000	
INCINERATION							Dewatered solids, bagged soils, additional residential soils Materials from sewer line removal;spent carbon
Load/haul/unload	19600	CY	5.00	98000	58800	156800	
Incineration	22540	TONS	250	5635000	NA	5635000	Site preparation, mobilization, trial burn, commissioning, operations, demobilization
Transport ash to RCRA landfill	1	LS	1960000	1960000	274400	2234400	Assume 750 mi haul to off-site RCRA landfill
Ash disposal fees	22540	TONS	130	2930200	NA	2930200	
Waste disposal tax	22540	TONS	27	608580	NA	608580	
Truck decontamination	2254	EA	100	225400	135240	360640	
				11457180	468440	$11,900,000	
(A5) SUBTOTAL				$22,521,010	$1,749,923	$23,900,000	
Bid contingencies (20% of Const. Subtotal)						$3,585,000	
Scope contingencies (30% of Const. Subtotal)						$5,975,000	
CONSTRUCTION TOTAL						$33,500,000	

COST ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST ($)	SUBTOTAL COST ($)	COST EXTENSION	TOTAL COST ($)	COMMENTS
ANNUAL O&M COSTS							
Inspect and maintain fence and warning si	1	LS	2500	2500			
Cap maintenance							
First year	1	LS	22000	22000			
After first year	1	LS	11000	11000			
Misc monitoring	1	LS	5000	5000			
Administrative costs	1	LS	10000	10000			
Maintenance reserve and contingency co	1	LS	17000	17000			
(A6a) TOTAL ANNUAL O&M				$57,000	(first year)		
				$46,000	(after first year)		
30 YEAR PRESENT WORTH COST =				$14,000,000			

LEGEND

Level D protective equipment = 1
Level C protective equipment = 2
NA - Not applicable

COST ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST ($)	SUBTOTAL COST ($)	COST EXTENSION	TOTAL COST ($)	COMMENTS
WATER COLLECTION AND TREATMENT							Filtrate from dewatering; water from decontamination of personnel & equipment
Site preparation	1	LS	15000	15000	2100	17100	Clearing, utility connections
Operation	1	MO	31560	31560	3640	35200	Mobil sedimentation/filtration/carbon adsorption
Pump water to discharge	7000000	GAL	0.02	140000	NA	140000	Electricity, analytical, operations
				186560	5740	$192,000	
INCINERATION							Dewatered sewer solids; excavated materials from sewer repa Spent carbon
Load/haul/unload	4650	CY	5	23250	13950	37200	
Incineration	5347.5	TONS	450	2406375	INCL	2406375	Site preparation, mobilization, trial burn, commissioning,
				2429625	13950	$2,444,000	
(A6a) SUBTOTAL				$7,663,310	$297,456	$7,960,000	
Bid contingencies (15% of Const. Subtotal)						$1,194,000	
Scope contingencies (25% of Const. Subtotal)						$1,990,000	
CONSTRUCTION TOTAL						$11,144,000	
Start-up (10% of dewatering and water treatment cost+ 5% of incineration costs)						$146,419	
Permitting and legal costs (3% of C.T.)						$334,000	
Service during const. (8% of C.T.)						$892,000	
Engineering and design (8% of C.T)						$892,000	
TOTAL IMPLEMENTATION COST						$2,264,000	
(A6a) TOTAL CAPITAL COST						$13,400,000	

COST ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST($)	SUBTOTAL COST ($)	COST EXTENSION	TOTAL COST ($)	COMMENTS
OLD STP							
Vacuum sludge from digester	890	CY	85	75650	45390	121040	Assuming 5% solids
Transport to sludge dewatering	1	LS	6200	6200	INCL	6200	Transport in tanker trucks, demurrange
Demolish digester, clarifiers, etc.	1	LS	470000	470000	65800	535800	Demolish all structures, bury in/over secondary clarifiers
Install 1 foot soil cover	1	LS	110000	110000	15400	125400	Cover sludge drying beds and secondary clarifier with soil
Fence area	1500	LF	8.80	13200	NA	13200	To restrict access and use
Post warning signs	15	EA	32	480	NA	480	Post signs 1 per 100 LF
				675530	126590	$802,000	
WEST WWTP							
Drain and/or pump water from aerat.basin	6800000	GAL	0.01	68000	9520	77520	Pump/Drain to ox. pond. Assume 7 ft of water
Cap drained aeration basin							Fill to grade with surrounding soil
Native fill	46000	CY	11	506000	70840	576840	
Topsoil	2400	CY	20	48000	NA	48000	
Sod	3	AC	12400	37200	NA	37200	
Fence area	7500	LF	8.80	66000	9240	75240	To restrict access and use around ox.ponds & aer.basins
Post warning signs	75	EA	32	2400	336	2736	Post signs 1 per 100 LF
				727600	89936	$818,000	
ROCKY BRANCH - FLOOD PLAIN							
Exc/Bckfill soils w/ TCDD > 1ppb	4100	CY	170.00	697000	INCL	697000	Grid 17 & 18 - undeveloped residential areas; prelim
				697000	0	$697,000	
SLUDGE DEWATERING							Incl.sewer sediment (10cy),digester sludge (890cy)
							Dewater sludge to 15% solids
Site preparation	1	LS	15000	15000	2100	17100	Clearing, utility connections
Dewatering operation	1	MO	31560	31560	15600	47160	Mobil plate and frame system
Pump water to water treatment	250000	GAL	0.02	5000	NA	5000	Electricity, analytical, operations
				51560	17700	$69,000	

VERTAC OFF-SITE FS COST ESTIMATE -- ALTERNATIVE 6b

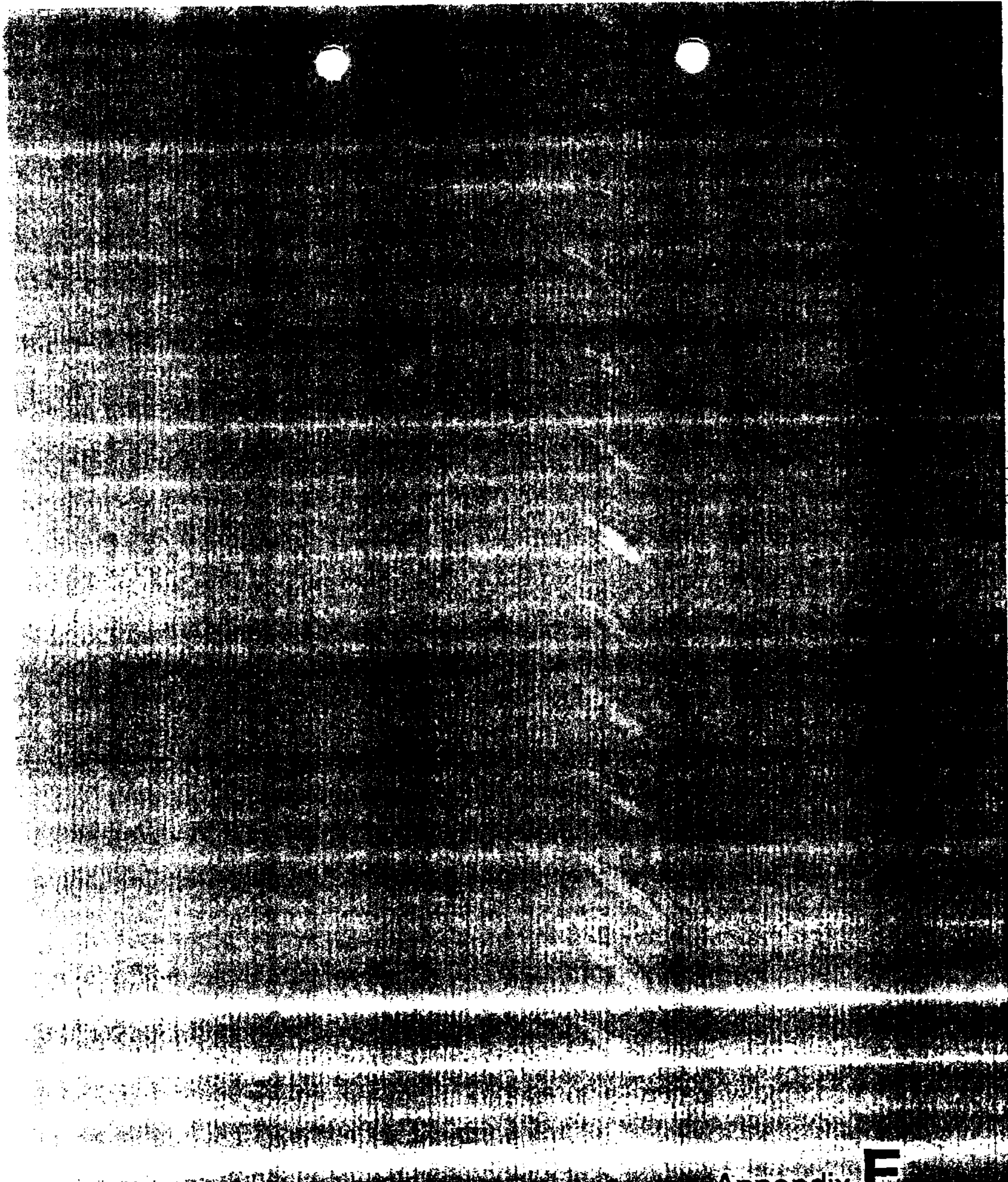
COST ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST($)	SUBTOTAL COST ($)	COST EXTENSION	TOTAL COST ($)	COMMENTS
GENERAL							Some line items include various general costs as indicated
Mobilization, Demobilization, Bonding, And Insurance	1	LS	566862	566862	NA	566862	10% of alt. SUBTOTAL, excluding incin & this line
Community Relations	1	LS	10000	10000	NA	10000	Prepare and plan public meetings, press briefing
Health & Safety Preparations							Based on sum total of labor for lines items
Worker Physicals	55	EA	500	27500	NA	27500	where health and safety preparations not included
Worker Training - initial	27	EA	3200	86400	NA	86400	
- refresher	27	EA	1250	33750	NA	33750	
Site Health & Safety -- PPE							Based on totals of C or D labor for line items
Personal Protective Equipment - Level C	475	MD	40	19014	NA	19014	where health and safety preparations not included
Personal Protective Equipment - Level D	3132	MD	20	62636	NA	62636	
Decontamination							
Decon Trailer	16	MO	1000	16000	NA	16000	Assume 1 decon trailer per crew of 5 in C/D
Vehicle Decontamination Station	1	LS	10000	10000	NA	10000	Temporary facility-HDPE on gravel,sump&pump,tank
Construction Administration Trailer	16	MO	270	4320	NA	4320	
Monitoring							
Background Air Monitoring	1	LS	50000	50000	NA	50000	High volume particulate sampling & analysis
Ambient Air Monitoring	3	MO	10000	30000	NA	30000	Ambient conditions & particulate monitoring (work areas)
				916482	0	$916,000	
COLLECTION LINES							
Repair exst sewer system (broken section	1	LS	466000	466000	INCL	466000	Assume 300 lf needs repair before flushing
Clean solids out of active sewer lines	1	LS	291000.00	291000	40740	331740	Hydraulic flushing, vacuuming, camera inspections
Maintain service of existing sewer system	1	LS	20000.00	20000	2800	22800	Temp sewer lines, pumping
Install pipe liners	10350	LF	100	1035000	NA	1035000	
Grout abandoned interceptor	1	LS	18000	18000	NA	18000	Pump grout into manholes to fill interceptor lines
				1830000	43540	$1,874,000	

COST ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST($)	SUBTOTAL COST ($)	COST EXTENSION	TOTAL COST ($)	COMMENTS
Start-up (10% of dewatering and water treatment cost+ 5% of incineration costs)						$52,981	
Permitting and legal costs (3% of C.T.)						$262,000	
Service during const. (8% of C.T.)						$699,000	
Engineering and design (8% of C.T)						$699,000	
TOTAL IMPLEMENTATION COST						$1,713,000	
(A6b) TOTAL CAPITAL COST						$10,400,000	
ANNUAL O&M COSTS							
Inspect and maintain fence and warning si	1	LS	1800	1800			
Cap maintenance (aeration basin & onsite consolid)							
First year	1	LS	29000	29000			
After first year	1	LS	15000	15000			
Misc monitoring	1	LS	5000	5000			
Administrative costs	1	LS	10000	10000			
Maintenance reserve and contingency co	1	LS	26000	26000			
(A6b) TOTAL ANNUAL O&M				$72,000	(first year)		
				$58,000	(after first year)		
30 YEAR PRESENT WORTH COST =				$11,000,000			

LEGEND

Level D protective equipment = 1
Level C protective equipment = 2
NA - Not applicable

COST ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST($)	SUBTOTAL COST ($)	COST EXTENSION	TOTAL COST ($)	COMMENTS
WATER COLLECTION AND TREATMENT							Filtrate from dewatering; water from decontamination of personnel & equipment
Site preparation	1	LS	15000	15000	2100	17100	Clearing, utility connections
Operation	1	MO	31560	31560	3640	35200	Mobil sedimentation/filtration/carbon adsorption
Pump water to discharge	7000000	GAL	0.02	140000	NA	140000	Electricity, analytical, operations
				186560	5740	$192,000	
CONSOLIDATE SOLIDS ONSITE							Dewatered sludge, bagged soil, incinerator ash
Load/Haul/Unload	4100	CY	5.00	20500	12300	32800	
Truck decontamination operations	345	EA	100.00	34500	4830	39330	
Spreading fill with bulldozer	4100	CY	2.00	8200	4920	13120	
RCRA Cap	0.6	AC	400000	240000	INCL	240000	Includes 2 ft. clay and synthetic membrane layers
				303200	22050	$325,000	
INCINERATION							Dewatered sewer solids; excavated materials from sewer repa Spent carbon
Load/haul/unload	550	CY	5	2750	1650	4400	
Incineration	632.5	TONS	850	537625	INCL	537625	Site preparation, mobilization, trial burn, commissioning, operations, demobilization
				540375	1650	$542,000	
(A6b) SUBTOTAL				$5,928,307	$307,206	$6,240,000	
Bid contingencies (15% of Const. Subtotal)						$936,000	
Scope contingencies (25% of Const. Subtotal)						$1,560,000	
CONSTRUCTION TOTAL						$8,736,000	



Appendix E

Summary Data Tables for Off-Site Areas

Sewage Collection Systems

SEWAGE COLLECTION SYSTEMS
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING LOCATION	SAMPLE DEPTH	1979 DATA	1981 DATA	1983 DATA	1984 DATA	1987 DATA
BACKGROUND (Vanberg Blvd.)	ABCD					ND-0.023
				EX 4.54		
	A			EX 1.77	EX ND-1.8	
	A			EX 33.1	AB 70.5	
BRADEN-ALTA mnhole		0.159	10.9			
line VERTAC-STP		1.13				
	A			AB 18.4	AB ND-3.81	
	A				AB 30.9	
	A			AB 0.11	AB 3.5	
	A			AB 1.92	EX 1.98	
mnhole of rcks/drt	A				AB 7.8	
	A				EX 6.6	
	A				AB 3.2	
	B				EX 1.7	
	A				EX 119.4	
	A				EX 0.09	
	A				EX 0.61	
	A				EX >200	
	A				EX ND-0.06	
	A				EX ND-0.46	
	A				EX 4.5	
	A				EX 22.3	

A = 0-3 inch
B = 3-6 inch
C = 6-9 inch
D = 9-12 inch

AB = abandoned line
EX = existing line

ND = non-detectable at given detection concentration

* Samples taken prior to 1983 are pre-RI samples by EPA and ADPC&E. Sampling protocols and exact locations for these pre-RI samples are unknown.

026167

Old STP Area

OLD STP AREA
SAMPLING DATA TABLE FOR 2,3,7,8 TCDD (ppb)

SAMPLING LOCATION (media)	SAMPLE DEPTH	1984 DATA	1987 DATA	1988 DATA*
BACKGROUND (Vanberg Blvd)	ABCD		ND-0.023	
PERIMETER (soil)	S			1.01 [66]
SLUDGE DRY BED (soil)	S			2.79DU [73]
	A	ND-0.01		
	A	0.77		
	B	6.59		
	B	0.58		
CLARIFIERS (sediments)	A	1.62		
	A	0.23		
CLARIFIER AREA (soil)	S			NA (0.307) [39]
SLUDGE DIGESTER (sediments)	B	5.3		
	B	12.46		
SLDG COLLCT. AREA (soil)	A	ND-0.076		
	A	ND-0.05		
	E	ND-0.21		
	E	0.42		
	X	ND-0.048		
	X	1.19		

A = 0-3 inch
S = surface sample
B = 3-6 inch
X = deep bottom samples
C = 6-9 inch
D = 9-12 inch
E = 12-15 inch
NA = not analyzed for 2,3,7,8-TCDD when TCDD < 1
( ) = non-isomer-specifc TCDD concentration
ND = non-detectable at given detection concentration
DU = duplicate associated with sample; highest value shown
* highest value of sampling grid used
[ ] = number of grabs taken in sampling grid

026169

Aeration Basin

AERATION BASIN
SAMPLING DATA TABLE FOR 2,3,7,8 TCDD (ppb)

SAMPLING LOCATION (media)	SAMPLE DEPTH	1984 DATA	1987 DATA	1988 DATA*
BACKGROUND (Vanberg Blvd)	ABCD		ND-0.023	
PERIMETER (soil)	S			NA (ND-0.3) [83]
NW QUAD (sludge)	S			NA (ND-0.3) [6]
	IN			NA (ND-0.3) [6]
NE QUAD (sludge)	A	37.9	2.9	
	E		1.5DU	
	F		1.7	
	S			1.41 [6]
	IN			NA (ND-0.3) [6]
SW QUAD (sludge)	A	6.5	2.7	
	E		0.8DU/SP	
	S			NA (0.71) [6]
	IN			NA (ND-0.3) [6]
SE QUAD (sludge)	A	16.2	7.6	
	G	2.08	1.9SP	
	S			2.83 DU [6]
	IN			NA(ND-0.3)DU [6]

A = 0-3 inch
B = 3-6 inch
C = 6-9 inch
D = 9-12 inch
E = 12-15 inch

F = 15-18 inch
G = 18-21 inch
H = 21-24 inch
I = 24-27 inch
J = 27-30 inch

S = surface sample
IN = interface sample b/w bottom sediment and liner

NA = not analyzed for 2,3,7,8-TCDD when TCDD < 1
( ) = non-isomer-specifc TCDD concentration
ND = non-detectable at given detection concentration
DU = duplicate associated with sample; highest value shown
SP = split sample; highest value shown
* highest value of sampling grid used
[ ] = number of grabs (surface samples) or cores (interface samples) taken in the sampling grid

0261771

Oxidation Pond

OXIDATION POND
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING LOCATION (media)	SAMPLE DEPTH	1979 DATA	1981 DATA	1983 DATA	1984 DATA	1987 DATA	1988 DATA*
BACKGROUND (Vanberg Blvd)	ABCD					ND-0.023	
PERIMETER (soil)	S						NA (ND-0.3) [58]
NORTH POND (sludge)		7.57					
NW QUAD	A				3.00	1.2	
	X				ND-0.7		
	D					0.4	
				0.59			
	S						0.29 [4]
	IN						NA (ND-0.3) [4]
NE QUAD	A				3.6		
	X				ND-0.98		
	A				1.8	1.8	
	F					0.025	
	X				ND-0.51		
				0.87			
	S						0.97 [4]
	IN						NA(ND-0.3)DU [4]
CENTER NORTH HALF				0.75			

OXIDATION POND
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING LOCATION (media)	SAMPLE DEPTH	1979 DATA	1981 DATA	1983 DATA	1984 DATA	1987 DATA	1988 DATA*
SOUTH POND (sludge)		8.37					
SW QUAD	A				1.98	0.41	
	X				ND-0.34		
	D					0.0061	
				0.67			
	S						NA (ND-0.3) [4]
	IN						NA (ND-0.3) [4]
SE QUAD	A				ND-0.92	1.3	
	G					ND-0.029	
	X				ND-0.44		
	A			2.52	ND-0.57		
	C					0.0059	
	X				0.2		
	A				1.3	1.1	
	J					0.015	
	X				ND-0.15		
				0.93			
	S						NA (ND-0.3) [4]
	IN						NA (ND-0.3) [4]
SOUTH EDGE	E					ND-0.82SP	
N & S POND COMPOSITE			3.4				

OXIDATION POND
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING LOCATION (media)	SAMPLE DEPTH	1979 DATA	1981 DATA	1983 DATA	1984 DATA	1987 DATA	1988 DATA*
OUTFALL DITCH							
crnr by OXPOND	A				ND-0.19		
				<0.80			
100'frm OXPOND	C				ND-0.13		
200'frm OXPOND	A				ND-0.07		
300'frm OXPOND	C				ND-0.14		
OUTFALL	A				0.74	0.45	
	S						NA(ND-0.3)DU[10]
	A				2	1.2SP	
	B				ND-0.15		
	C				ND-0.15		
	**						NA(ND-0.3)DU[26]
	A				3.5	0.5SP	
	B				1.1	0.6SP	
	C				2.1	0.68	
	**						NA(ND-0.3)DU[26]
25'below outfall	X				ND-0.3		
	A				ND-0.4		
	B				ND-0.13		
	C				ND-0.15		
	C				ND-0.1		

Rocky Branch in the Vicinity of STP

ROCKY BRANCH IN THE VICINITY OF STP
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1979 DATA	1983 DATA	1984 DATA	1987 DATA	1988 DATA*
BACKGROUND	VANBERG BLVD	ABCD				ND-0.023	
WEST MAIN ST BRIDGE	E BANK	S					NA (ND-0.3)[36]
REDMOND RD.				0.13			
MANHOLE 2043	W of RB b/w RDMND Rd & MPRR	S					NA (ND-0.3)[36]
CORY DRIVE		C			ND-0.73		
ROCKY BRANCH S REDMOND RD - HWY 167							
	INSTREAM	A			ND-0.17	0.098SP	
		B			ND-0.05		
		C			ND-0.08		
		A			0.15	0.046SP	
		B			0.39		
		C			0.18		
		A			0.16	0.86	
		X			ND-0.02		
	NEAR STREAM	A			1.7	0.97SP	
		C			ND-0.33		
		A			ND-0.05	0.0049	
		S					NA(0.569)DU[50]
		A			0.27		

ROCKY BRANCH IN THE VICINITY OF STP
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1979 DATA	1983 DATA	1984 DATA	1987 DATA	1988 DATA*
	NEAR STREAM	B			ND-0.13		
		C			ND-0.08		
		A			ND-0.7		
		A				0.64	
		S					NA (ND-0.3)[25]
		C			1.5	0.85SP	
		A			ND-0.11	0.63	
		B			ND-0.02		
		C			ND-0.2		
		C			ND-0.094		
		C			ND-0.02		
ROCKY BRANCH SOUTH OF HWY 167							
	INSTREAM	C			ND-0.19		
		A			ND-0.08		
		B			ND-0.1		
		C			ND-0.06		
		A			0.41	0.52	
		B			0.1		
		C			ND-0.11		
		C			ND-0.12		
HWY 167			0.384				
			2.5	1.15			

ROCKY BRANCH IN THE VICINITY OF STP
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1979 DATA	1983 DATA	1984 DATA	1987 DATA	1988 DATA*

A = 0-3 inch
B = 3-6 inch
C = 6-9 inch
D = 9-12 inch

S = surface sample
X = deep bottom sample

NA = not analyzed for 2,3,7,8-TCDD when TCDD < 1
( ) = non-isomer-specifc TCDD concentration
ND = non-detectable at given detection concentration
DU = duplicate associated with sample; highest value shown
SP = split sample; highest value shown
* Highest value of sampling grid used
** Samples taken prior to 1983 are pre-RI samples by EPA and ADPC&E.
Sampling protocols and exact locations for these pre-RI samples are unkown.
[ ] = number of grabs taken in the sampling grid

Vertac Property Line &
Rocky Branch

VERTAC PROPERTY LINE & ROCKY BRANCH
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING GRID NO.	GRID AREA	1987 DATA	1988 DATA	1989 DATA
BACKGROUND * (Vanberg Blvd.)			ND-0.023		
VERTAC PROPERTY	1A	20' X 250'			1.382
LINE **	2A	20' X 250'			0.608
	3A	20' X 250'			0.543
	4A	20' X 250'			1.686
	5A	20' X 250'			NA(ND-0.3)
	6A	20' X 250'			NA(ND-0.3)
	7A	20' X 250'			0.502
	8A	20' X 250'			NA(ND-0.3)
WEST SHORE	1	20' X 250'		NA(ND-0.3)	
ROCKY BRANCH	2	20' X 250'		NA(ND-0.3)	
WEST LEG	3	20' X 250'		0.92	
PROPERTY LINE -	4	20' X 250'		0.852	
CONFLUENCE **	5	20' X 250'		0.765	
	6	20' X 250'		0.423	
	7	20' X 250'		<.317	
	8	20' X 250'		NA(ND-0.3)	
	9	20' X 250'		3.769	
	10	20' X 250'		1.9	
	11	20' X 250'		1.422	
	12	20' X 250'		0.804	
	13	20' X 250'		2.537	
	14	20' X 250'		2.361	
	15	20' X 250'		4.779	
	16	20' X 250'		2.736	
	17	20' X 215'		8.485	
	18	20' X 215'		9.653	
RESIDENTIAL AREAS **					
BRADEN	1-4	10' X 200'		1.135	
HICKS	12-14	20 X 100'		ND-0.53	
ROTE	16-18	20 X 100'		ND-0.2	
SWELL 1	20-22	20 X 100'		0.6	
SWELL 2	23-25	20 X 100'		0.31	
GRID 3	26-28	20 X 100'		0.26	
GRID 4	29-31	20 X 100'		0.25	

VERTAC PROPERTY LINE & ROCKY BRANCH
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING GRID NO.	GRID AREA	1987 DATA	1988 DATA	1989 DATA
1924 MAIN ST.					
BLDG DUST	7-10			ND-1ng/sample	
DIRT PILES	6			0.569	

NA = not analyzed for 2,3,7,8-TCDD when TCDD < 1
( ) = non-isomer-specifc TCDD concentration
ND = non-detectable at given detection concentration
* Sampled at 0-3,3-6,6-9,9-12 inch depths.
** 3 samples taken per grid, highest value shown.

026182

Rocky Branch Floodplain

ROCKY BRANCH FLOODPLAIN
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1979 DATA	1981 DATA	1983 DATA	1984 DATA	1987 DATA	1988 DATA*
BACKGROUND	VANBERG BLVD	ABCD					ND-0.023	
W.LEG(0-250ft.	0-20ft.frm crk	S						2.88 [150]
frm junct.of		S						2.01 [150]
W and E legs)		S						NA (ND-0.3) [150]
	20-40ft.frm crk	S						1.98 [150]
		S						1.68 [150]
		S						1.79 [150]
	40-60ft.frm crk	S						NA (0.869) [150]
		S						NA (0.723) [150]
		S						NA (0.794) [150]
								[150]
W.LEG(250-500ft.	0-20ft.frm crk	S						2.73 [150]
frm junct.of		S						2.67 [150]
W and E legs)		S						2.53 [150]
	20-40ft.frm crk	S						2.02 [150]
		S						1.83 [150]
		S						1.9 [150]
	40-60ft.frm crk	S						1.74 [150]
		S						1.08 [150]
		S						0.96 [150]
	60-80ft.frm crk	S						1.45 [150]
		S						1.15 [150]
		S						1.32 [150]
	80-100ft.frm crk	S						1.34 [150]
		S						1.23 [150]
		S						1.28 [150]
	100-120ft. frm crk	S						NA (0.96) [150]

ROCKY BRANCH FLOODPLAIN
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1979 DATA	1981 DATA	1983 DATA	1984 DATA	1987 DATA	1988 DATA*	
		S						NA (0.849)	[150]
		S						NA (0.890)	[150]
									[150]
W.LEG(500-750ft.	0-20ft.frm crk	S						1.26	[150]
frm junct.of		S						1.81	[150]
W and E legs)		S						1.85DU	[150]
	20-40ft.frm crk	S						NA (0.738)	[150]
		S						0.65	[150]
		S						1.55	[150]
W.LEG(500-750ft.	40-60ft.frm crk	S						NA (ND-0.3)	[150]
frm junct.of		S						NA (ND-0.3)	[150]
W and E legs)		S						NA (0.417)	[150]
									[150]
W.LEG(750-930ft.	0-20ft.frm crk	S						NA (0.728)	[150]
frm junct.of		S						NA (0.412)	[150]
W and E legs)		S						0.95	[150]
	20-40ft.frm crk	S						1.09	[150]
		S						0.87	[150]
		S						1.42	[150]
	40-60ft.frm crk	S						NA (0.695)	[150]
		S						NA (0.584)	[150]
		S						NA (0.729)	[150]
W.LEG	S of GREGORY RD.	A				ND-0.065			
		C				ND-0.19			
	GEN.SAMUEL RD.		<0.05	<0.07					

026185

ROCKY BRANCH FLOODPLAIN
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1979 DATA	1981 DATA	1983 DATA	1984 DATA	1987 DATA	1988 DATA*
REDMOND RD.								
E side ditch	1 mi N of W.MAIN			<0.03				
end of road			<0.021					
E.LEG(0-250ft.	0-20ft.frm crk	S						NA (ND-0.3) [150]
frm junct.of		S						NA (ND-0.3) [150]
W and E legs)		S						NA (ND-0.3) [150]
E.LEG(250-500ft.	0-20ft.frm crk	S						NA (ND-0.3) [150]
frm junct.of		S						NA (ND-0.3) [150]
W and E legs)		S						NA (ND-0.3) [150]
E.LEG(500-750ft.	0-20ft.frm crk	S						NA (ND-0.3) [150]
frm junct.of		S						NA (ND-0.3) [150]
W and E legs)		S						NA (ND-0.3) [150]
E.LEG(750-1000ft.	0-20ft.frm crk	S						NA (ND-0.3) [150]
frm junct.of		S						NA(ND-0.3)DU [150]
W and E legs)		S						NA (ND-0.3) [150]
E.LEG(1000-1250ft.	0-20ft.frm crk	S						NA (ND-0.3) [150]
frm junct.of		S						NA (ND-0.3) [150]
W and E legs)		S						1.11 [150]
	resample (1.11)	S						NA (ND-0.3) [150]
	1000ft to road	S						NA (ND-0.3) [150]
	road to 1250ft	S						NA (ND-0.3) [150]
	drt ple @ fnc crnr	S						NA (ND-0.3) [150]

ROCKY BRANCH FLOODPLAIN
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1979 DATA	1981 DATA	1983 DATA	1984 DATA	1987 DATA	1988 DATA*
	20-40ft.frm crk	S						NA (ND-0.3) [150]
		S						NA (ND-0.3) [150]
		S						NA (ND-0.3) [150]
E.LEG(1250-1500ft.	0-20ft.frm crk	S						NA (ND-0.3) [150]
frm junct.of		S						NA (ND-0.3) [150]
W and E legs)		S						NA (ND-0.3) [150]
E.LEG(1500-1750ft.	0-20ft.frm crk	S						NA (ND-0.3) [150]
frm junct.of		S						NA (ND-0.3) [150]
W and E legs)		S						NA(ND-0.3)DU [150]
E.LEG(1750-1880ft.	0-20ft.frm crk	S						NA (ND-0.3) [150]
frm junct.of		S						NA (ND-0.3) [150]
W and E legs)		S						NA (ND-0.3) [150]
EAST LEG	SMITHWICK DR.			<0.035				
	SE crnr of VERTAC			0.8				
	INSTREAM	C				0.1		
HINES DRIVE	WOODED AREA	A					6.8	
	(end of st.)	C				7.58	1.3SP	
		A				ND-0.23		
		C				ND-0.12		
	Lot 11		<0.041					
3002 HINES	rt edge of lawn		0.028					

ROCKY BRANCH FLOODPLAIN
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1979 DATA	1981 DATA	1983 DATA	1984 DATA	1987 DATA	1988 DATA*	
3026 HINES	garden		0.004						
3105 HINES	garden soil		<0.040						
HINES COVE		A				ND-0.069			
		C				ND-0.37			
WEST LANE	RUNOFF DITCH	A				0.84	0.12		
		C				3.01	0.011SP		
	Lot 21		2.6						
2111 WEST LANE	0-20ft.frm crk	S						NA (ND-0.3)	[11]#
		S						NA (ND-0.3)	[11]#
		S						NA (0.546)	[11]#
2113 WEST LANE	0-20ft.frm crk	S						NA (ND-0.3)	[26]#
		S						NA (ND-0.3)	[26]#
		S						NA(ND-0.3)DU	[26]#
2112 WEST LANE	0-20ft.frm crk	S						3.43	[15]#
		S						4.18	[15]#
		S						3.59	[15]#
	20-40ft.frm crk	S						1.24	[22]#
		S						2.74	[22]#
		S						1.51	[22]#
	40-60ft.frm crk	S						NA (0.539)	[32]
		S						NA (0.716)	[32]
		S						NA (0.575)	[32]

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ROCKY BRANCH FLOODPLAIN
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1979 DATA	1981 DATA	1983 DATA	1984 DATA	1987 DATA	1988 DATA*
BRADEN STREET	14ft frm manhole	A					ND-0.19	
	lawn at W end of st.		0.456					
CREEK	INSTREAM					ND-0.58		
2203 BRADEN	0-20ft.frm crk	S						1.87 [46]#
		S						2.39 [46]#
		S						2.27 [46]#
	20-40ft.frm crk	S						1.2 [35]#
		S						1.21 [35]#
		S						1.11 [35]#
	40-60ft.frm crk	S						NA (ND-0.3) [27]
		S						0.33 [27]
		S						NA (ND-0.3) [27]
	60-80ft.frm crk	S						NA (ND-0.3) [24]
		S						NA (ND-0.3) [24]
		S						NA (ND-0.3) [24]
2202 BRADEN	0-20ft.frm crk	S						1 [49]#
		S						1.16 [49]#
		S						1.66DU [49]#
	20-40ft.frm crk	S						NA (0.896) [44]#
		S						NA (0.710) [44]#
		S						NA (0.906) [44]#
	40-60ft.frm crk	S						NA (ND-0.3) [36]
		S						NA (0.387) [36]
		S						NA (ND-0.3) [36]

ROCKY BRANCH FLOODPLAIN
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1979 DATA	1981 DATA	1983 DATA	1984 DATA	1987 DATA	1988 DATA*	
2200 BRADEN	yard soil			0.03					
2113 BRADEN	garden soil			<0.085					
	SW crnr backyard			<0.045					
	rose garden		4.2						
CREEK	west keg		0.236						
intersection	BRADEN & HINES		<0.021						
ALTA COVE									
618 ALTA COVE	0-20ft.frm crk	S						NA (0.838)	[44]#
		S						0.78	[44]#
		S						NA (0.631)DU	[44]#
	20-40ft.frm crk	S						NA (0.424)	[40]
		S						NA (0.430)	[40]
		S						NA (0.385)	[40]
620 ALTA COVE	0-20ft.frm crk	S						NA (0.382)	[33]
		S						NA (0.566)	[33]
		S						NA (0.482)	[33]
	NW crnr backyard			0.05					
	garden soil			0.069					
	near S fence		0.47						
LOT 36			0.058						

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ROCKY BRANCH FLOODPLAIN
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1979 DATA	1981 DATA	1983 DATA	1984 DATA	1987 DATA	1988 DATA*	
ALTA LANE	N end of LN		<0.027						
625 ALTA	N end of house		<0.021						
OAKLEY LANE									
624 OAKLEY	garden soil			0.013					
608 OAKLEY	manhole #2734	S						NA (ND-0.3)	[8]
		S						NA (ND-0.3)	[8]
		S						NA (ND-0.3)	[8]
617 OAKLEY	manhole #2735	S						NA (ND-0.3)	[35]
		S						NA (ND-0.3)	[35]
		S						NA (ND-0.3)	[35]
CARPENTER DR.									
628 CARPENTER	N end of house		<0.029						
BROOKHAVEN COURT									
601 BROOKHAVEN	0-20ft.frm crk	S						NA (ND-0.3)	[14]
		S						NA (ND-0.3)	[14]
		S						NA (ND-0.3)	[14]
605 BROOKHAVEN	0-20ft.frm crk	S						NA(ND-0.3)DU	[14]
		S						NA (ND-0.3)	[14]

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ROCKY BRANCH FLOODPLAIN
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1979 DATA	1981 DATA	1983 DATA	1984 DATA	1987 DATA	1988 DATA*
		S						NA (ND-0.3) [14]
609 BROOKHAVEN	0-20ft.frm crk	S						NA (ND-0.3) [14]
		S						NA (ND-0.3) [14]
		S						NA (ND-0.3) [14]
613 BROOKHAVEN	0-20ft.frm crk	S						NA (ND-0.3) [14]
		S						NA (ND-0.3) [14]
		S						NA (ND-0.3) [14]
617BROOKHAVEN	0-20ft.frm crk	S						NA (ND-0.3) [14]
		S						NA (ND-0.3) [14]
		S						NA (ND-0.3) [14]
621 BROOKHAVEN	0-20ft.frm crk	S						NA (ND-0.3) [14]
		S						NA (ND-0.3) [14]
		S						NA (ND-0.3) [14]
625 BROOKHAVEN	0-20ft.frm crk	S						NA (ND-0.3) [26]
		S						NA(ND-0.3)DU [26]
		S						NA(ND-0.3)DU [26]
629 BROOKHAVEN	0-20ft.frm crk	S						NA (ND-0.3) [13]
		S						NA (ND-0.3) [13]
		S						NA (ND-0.3) [13]
HILL ROAD								

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ROCKY BRANCH FLOODPLAIN
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1979 DATA	1981 DATA	1983 DATA	1984 DATA	1987 DATA	1988 DATA*
1703 HILL	0-20ft.frm crk	S						NA (ND-0.3) [33]
		S						NA (ND-0.3) [33]
		S						NA (ND-0.3) [33]
1704 HILL	0-20ft.frm crk	S						2.78 [31]#
		S						1.31 [31]#
		S						1.83 [31]#
	30ft so of ditch	S						2.66 [21]#
		S						3.65 [21]#
		S						2.30DU [21]#
	20-40ft frm crk	S						2.08 [32]#
		S						5.97 [32]#
		S						4.61 [32]#
	30ft. so of ditch	S						5.76 [21]#
		S						12.32 [21]#
		S						10.92 [21]#
	north of ditch	S						NA (0.335) [24]#
		S						NA (0.334) [24]#
		S						NA (0.372) [24]#
	40-60ft. frm crk	S						1.82 [28]#
		S						2.44 [28]#
		S						1.69 [28]#
	60-80ft. frm crk	S						NA (ND-0.3) [28]#
		S						NA (0.894) [28]#
		S						NA (0.603) [28]#
	manhole #2745	S						11.84 [36]#
		S						7.68 [36]#
		S						6.12 [36]#

ROCKY BRANCH FLOODPLAIN
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1979 DATA	1981 DATA	1983 DATA	1984 DATA	1987 DATA	1988 DATA*
	80ftE of mnhol2745	S						4.8 [32]#
		S						3.34DU [32]#
		S						3.19 [32]#
	DITCH W of #2745	S						54.73 [10]
	#2745 N of ditch	S						3.09DU [40]#
		S						3.85 [40]#
		S						3.25 [40]#
	#2745 S of ditch	S						NA (0.519) [25]#
		S						NA (ND-0.3) [25]#
		S						NA (ND-0.3) [25]#
	low area N of pool	S						6.52 [36]#
		S						11.65 [36]#
		S						7.16 [36]#
	backyard			<0.07				
MANHOLE #1152		S						NA (ND-0.3) [30]
		S						NA (ND-0.3) [30]
		S						NA (ND-0.3) [30]
1709 HILL	garden soil		0.052					
1712 HILL	manhole #2741	S						NA (ND-0.3) [35]
		S						NA (ND-0.3) [35]
		S						NA (ND-0.3) [35]
1804 HILL	manhole #2740	S						NA (ND-0.3) [35]
		S						NA (ND-0.3) [35]
		S						NA (ND-0.3) [35]

ROCKY BRANCH FLOODPLAIN
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1979 DATA	1981 DATA	1983 DATA	1984 DATA	1987 DATA	1988 DATA*
1712 and 1804	backyards	S						NA (ND-0.3) [7]
EAST LEG				0.535				
REBEL DR. (1982 SAMPLES)								
1446 REBEL	under bldg			<0.025				
1519 REBEL	boring			<0.025				
1515 REBEL	front yard			<0.025				
	backyard			<0.025				
drainage ditch	(behind REBEL)			<0.025				
MARSHALL RD.								
intersection	MARSHALL & REBEL			<0.088				
drainage ditch				0.61				
Lutheran residence				<0.042				
E of Marshall	S of Gregory		<0.04					
RANDOM GROSS GRID SAMPLING RESULTS								
604 BROOKHAVEN		S						NA (ND-0.3) [3]
604 CHERYL		S						NA (ND-0.3) [3]
2200 BRADEN		S						NA (ND-0.3) [3]

ROCKY BRANCH FLOODPLAIN
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1979 DATA	1981 DATA	1983 DATA	1984 DATA	1987 DATA	1988 DATA*
2111 BRADEN		S						NA (ND-0.3) [3]
2113 BRADEN		S						NA (ND-0.3) [6]
field behind BRADEN church		S						NA (ND-0.3) [3]
vacant lot on HINES		S						NA (ND-0.3) [3]
BANKS OF WEST AND EAST LEGS								
WEST LEG	0-500ft lft bank	S						0.61 [50]
(6in above water)	0-500ft rt bank	S						0.99 [50]
	510-1000ft lft bnk	S						0.76 [50]
	510-1000ft rt bank	S						0.65 [50]
	1010-1500ft lft bnk	S						0.61 [50]
	1010-1500ft rt bank	S						0.55 [50]
	1510-2000ft lft bnk	S						0.54DU [50]
	1510-2000ft rt bank	S						0.7 [50]
	2010-2230ft lft bnk	S						ND - 0.59 [50]
	2010-2230ft rt bank	S						- [50]
EAST LEG	10-500ft lft bank	S						NA (0.387) [50]
(6in above water)	10-500ft rt bank	S						NA (ND-0.3) [50]
	510-1000ft lft bnk	S						NA (ND-0.3) [50]
	510-1000ft rt bank	S						NA (ND-0.3) [50]
	1010-1500ft lft bnk	S						NA (0.475) [46]
	1010-1500ft rt bank	S						NA (0.872) [46]

ROCKY BRANCH FLOODPLAIN
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1979 DATA	1981 DATA	1983 DATA	1984 DATA	1987 DATA	1988 DATA*
	1510-2000ft lft bnk	S						NA (0.632) [44]
	1510-2000ft rt bank	S						NA (ND-0.3) [44]
	2010-2500ft lft bnk	S						NA (0.682) [50]
	2010-2500ft rt bank	S						NA (0.335) [50]
	2510-2940ft lft bnk	S						NA(0.304)DU [37]
	2510-2940ft rt bank	S						0.16 [37]
(resample)	2510-2940ft rt bank	S						NA (ND-0.3) [37]
(12in above wtr)	2510-2940ft rt bank	S						NA (ND-0.3) [37]
BOTTOM SEDIMENT WEST AND EAST LEGS								
CONFLUENCE		S						NA (ND-0.3) [1]
WEST LEG	VERTAC fence	S						NA (ND-0.3) [1]
EAST LEG	1704 HILL	S						NA(ND-0.3)DU [1]
NEAR SITE N of WEST MAIN								
					<0.011			
					<0.008			
					0.064			
					<0.013			
					0.042			
					0.03			
					<0.01			
					0.17			

ROCKY BRANCH FLOODPLAIN
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1979 DATA	1981 DATA	1983 DATA	1984 DATA	1987 DATA	1988 DATA*
					0.47			
					0.9			
					33.4			
					0.11			
					0.94			
					0.012			
					0.77			
					0.1			
					0.41			
					0.019			
					0.128			
					0.25			
WEST MAIN						0.14		
					3.2			
					0.246			
					<0.074			
					<0.077			
				0.27				

ROCKY BRANCH FLOODPLAIN
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1979 DATA	1981 DATA	1983 DATA	1984 DATA	1987 DATA	1988 DATA*

A = 0-3 inch S = surface sample
B = 3-6 inch
C = 6-9 inch
D = 9-12 inch
NA = not analyzed for 2,3,7,8-TCDD when TCDD < 1
( ) = non-isomer-specifc TCDD concentration
ND = non-detectable at given detection concentration
DU = duplicate associated with sample; highest value shown
SP = split sample; highest value shown
* Highest value of sampling grid used
** Samples taken prior to 1983 are pre-RI samples by EPA and ADPC&E.
Sampling protocols and exact locations for these pre-RI samples are unknown.
[ ] = number of grabs in sampling grid
= sample areas represented by these samples have been excavated by Hercules

Bayou Meto and Floodplain

BAYOU METO AND FLOODPLAIN
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1979 DATA	1981 DATA	1983 DATA	1984 DATA	1987 DATA	1988 DATA*
BACKGROUND	VANBERG BLVD	ABCD					ND-0.023	
					<0.010			
					<0.012			
					<0.011			
					<0.10			
BAYOU METO BANKS AND INSTREAM								
.1-.88 mi		X				ND-0.80		
below outfall		X				0.19		
	HWY 167	A			<0.020	0.27	0.024SP	
		X				0.04		
		X				ND-0.082		
		A				ND-0.47	0.036SP	
		B				ND-0.21		
		C				ND-0.33		
	CONFLUENCE	A				0.53	0.29	
		X				0.88		
		D					ND-0.0065	
		A			0.58	0.74	0.8SP	
.88-2.4 mi	SOYBEAN FLD.	A				0.06	0.068DU	
below outfall	DRY CREEK	A				0.9		
		A				0.37	1	
		X				ND-0.04		
		A				0.1	1.03	
		X				0.1		
		**						NA (ND-0.3) [50]

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BAYOU METO AND FLOODPLAIN
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1979 DATA	1981 DATA	1983 DATA	1984 DATA	1987 DATA	1988 DATA*
		A				0.81	0.34	
		B				1.2	0.12SP	
		C				1.1	0.33	
		**						NA (ND-0.3) [38]
	BAY MOUTH	A			0.044	0.86	0.41SP	
	WOODLAND	A					0.098	
		C				1.58	0.0046SP	
		A					0.49	
		C				1.3		
		A				1.1	0.53	
		A				0.54	0.85SP	
		B				1.52	0.75SP	
		C				0.4		
		B				0.78	0.64	
		C				ND-0.16	1.7SP	
		X				0.2		
		A				0.81		
		B				1.2		
		C				1.1		
		A				0.39	0.22	
	RR TRACK	A			1.02	0.34	0.25	
		A				0.61		
		**						NA (ND-0.3) [50]
		**						NA (ND-0.3) [50]
		A				0.25	0.18	
		A				0.31	0.18	
		X				1.1		
		D					0.0029	

BAYOU METO AND FLOODPLAIN
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1979 DATA	1981 DATA	1983 DATA	1984 DATA	1987 DATA	1988 DATA*
		**						NA (ND-0.3) [50]
		**						NA (ND-0.3) [42]
	HWY 161	A			0.35	ND-0.79	0.14SP	
		X				ND-0.08		
				0.5				
				<0.010				
				0.3				
				1.6				
2.4-3.23 mi		A					0.22DU	
below outfall		C				1.08	0.54DU/SP	
						0.59		
3.23-4.09 mi	IRRIGATION DITCH	A				ND-0.09	ND-0.0055DU/SP	
below outfall	HWY 391				<0.009			
					0.014			
LONOKE CNTY	W edge county line	A					0.24	
LINE		X				ND-0.03		
		X				ND-0.03		
	above SHEFF. LK.	X				ND-0.02		
HWY 15	below I40	A			0.015		0.0044	
					<0.021			
				0.023				
				<0.07				
			0.036					

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BAYOU METO AND FLOODPLAIN
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1979 DATA	1981 DATA	1983 DATA	1984 DATA	1987 DATA	1988 DATA*
HWY 31					<0.021			
					<0.02			
					<0.1			
					<0.07			
			0.036					
HWY 13				<0.02				
				<0.085				
			0.04					
HWY 79				<0.02				
				<0.08				
			<0.018					
	E of RR bridge	A				0.061		
BENSON BRIDGE				<0.02				
				<0.02				
			ND					
HWY 152				<0.02				
				<0.03				
			0.034					
HWY 11				<0.02				
				<0.02				
			<0.025					

026204

BAYOU METO AND FLOODPLAIN
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1979 DATA	1981 DATA	1983 DATA	1984 DATA	1987 DATA	1988 DATA*
ARKANSAS RIVER	BAYOU JUNCTION		<0.02					
BAYOU METO FLOODPLAIN								
.1-.88 mi below outfall	HWY 167			0.6				
				ND				
			0.07	0.25				
	2yr fldpln	A				0.23		
		B				0.24		
		C				0.07		
		C				ND-0.03		
		A				ND-0.64		
		A				ND-0.55		
	b/w 2&5yr fldpln	C				ND-0.17		
		A				ND-0.90		
		C				ND-0.03		
.88-2.4 mi below outfall	S DUPREE PARK	A				0.22	0.36DU	
		C				ND-0.08		
		C				ND-0.06		
	LK.DUPREE (1980)			0.228				
	BALL PARK (1980)			<0.022				
				<0.012				
N of BAYOU METO	1.5 mi above mouth of BAYOU METO		<0.009					

BAYOU METO AND FLOODPLAIN
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1979 DATA	1981 DATA	1983 DATA	1984 DATA	1987 DATA	1988 DATA*
						0		
						0		
						0		
	MIDDLE IMPNDMNT	A				ND-0.02		
		A				ND-0.06		
		A				ND-0.13		
	SE of OX POND	A				ND-0.02		
						0.43		
						0		
						0		
						0		
		A				ND-0.09		
						0		
						0		
		C				ND-0.04		
		C				ND-0.22		
	E of OX POND				<0.010			
N of BAYOU METO	2 yr fldpln	C				0.05		
					0.2			
					<0.17			
		C				ND-0.32		
		C				ND-0.063		
		C				ND-0.13		
		C				ND-0.082		
	b/w 2&5 yr fldpln	C				ND-0.83		
		C				ND-0.15		
		C				ND-0.052		

BAYOU METO AND FLOODPLAIN
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1979 DATA	1981 DATA	1983 DATA	1984 DATA	1987 DATA	1988 DATA*
S of BAYOU METO	2 yr fldpln	C				ND-0.054		
		C				ND-0.06		
		C				ND-0.01		
		C				1.08		
		C				ND-0.2		
		C				ND-0.06		
		A				ND-0.44		
		A				0.9		
		A				ND-0.22		
		C				ND-0.07		
		A				ND-0.16		
		A				ND-0.09		
		C				ND-0.062		
		C				ND-7.79		
		C				ND-0.14		
		A				ND-0.05		
		A				ND-0.06		
	KELLOGG CREEK				<0.1			
	SOUTH IMPNDMNT	A				ND-0.052		
		A				ND-0.041		
		A				ND-0.026		
		A				ND-0.042		
		X				ND-0.044		
	b/w 2&5 yr fldpln	A				ND-0.02		
		A				ND-0.02		
		A				ND-0.01		
		A				ND-0.04		

BAYOU METO AND FLOODPLAIN
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1979 DATA	1981 DATA	1983 DATA	1984 DATA	1987 DATA	1988 DATA*
		A				ND-0.06		
		A				ND-0.03		
		A				ND-0.04		
		A				ND-0.01		
		C				ND-0.06		
		C				ND-0.04		
	5 yr fldpln	A				ND-0.02		
		A				ND-0.01		
	S of FEARS LAKE	A				ND-0.03		
	(E of HWY 167)	A				ND-0.04		
		A				ND-0.04		
		X				ND-0.05		
		A				ND-0.05		
		X				ND-0.03		
					<0.010			
					<0.011			
					<0.014			
					<0.007			
					<0.010			
					<0.008			
					<0.015			
					<0.005			
					<0.010			
					<0.012			
					<0.009			

BAYOU METO AND FLOODPLAIN
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING AREA	SAMPLING LOCATION	SAMPLE DEPTH	1979 DATA	1981 DATA	1983 DATA	1984 DATA	1987 DATA	1988 DATA*

A = 0-3 inch
B = 3-6 inch
C = 6-9 inch
D = 9-12 inch

S = surface sample
X = deep bottom sample

NA = not analyzed for 2,3,7,8-TCDD when TCDD < 1
( ) = non-isomer-specific TCDD concentration
ND = non-detectable at given detection concentration
DU = duplicate associated with sample: highest value shown
SP = split sample; highest value shown
* Highest value of sampling grid shown
** Samples taken at 6, 36, and 60 inches
[ ] = number of grabs taken in sampling grid

NOTE: Samples taken prior to 1983 are pre-RI samples by EPA and ADPC&E.
Sampling protocols and exact locations for these pre-RI samples are unknown.

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LAKE DUPREE
SAMPLING DATA TABLE FOR 2,3,7,8-TCDD (ppb)

SAMPLING LOCATION	SAMPLE DEPTH	1980 DATA	1984 DATA	1987 DATA	1988 DATA
BACKGROUND (Vanberg Blvd.)	ABCD			ND-0.023	
PERIMETER	S				NA(ND-0.3) [38]
QUADRANT 1	S				NA(ND-0.3) [6]
(N end of lake)	A		0.37		
	X		0.18		
QUADRANT 2	S				NA(ND-0.3) [6]
	A		0.1		
	X		0.05		
	A		0.11		
QUADRANT 3	S				NA(ND-0.3) [6]
QUADRANT 4 (S end of lake)	S				NA(ND-0.3) [6]
West shore		0.228			

A = 0-3 inch
B = 3-6 inch
C = 6-9 inch
D = 9-12 inch

S = surface sample
X = deep bottom samples

NA = not analyzed for 2,3,7,8-TCDD when TCDD < 1
( ) = non-isomer-specifc TCDD concentration
ND = non-detectable at given detection concentration
* Highest value of sampling grid used
** Samples taken prior to 1983 are pre-RI samples by EPA and ADPC&E.
Sampling protocols and exact locations for these pre-RI samples are unknown.
[ ] = number of grabs in sample

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